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Important

WARNING/CAUTION/NOTE

Please read this manual and follow its instructions carefully. To emphasize special information, the words **WARNING**, **CAUTION** and **NOTE** have special meanings. Pay special attention to the messages highlighted by these signal words.

WARNING:

Indicates a potential hazard that could result in death or injury.

CAUTION:

Indicates a potential hazard that could result in vehicle damage.

NOTE:

Indicates special information to make maintenance easier or instructions clearer.

WARNING:

This service manual is intended for authorized SUZUKI dealers and qualified service mechanics only. Inexperienced mechanics or mechanics without the proper tools and equipment may not be able to properly perform the services described in this manual.
Improper repair may result in injury to the mechanic and may render the vehicle unsafe for the driver and passengers.

WARNING:

For vehicles equipped with a Supplemental Restraint (Air Bag) System :

- **Service on and around the air bag system components or wiring must be performed only by an authorized SUZUKI dealer. Refer to "Air Bag System Components and Wiring Location View" under "General Description" in air bag system section in order to confirm whether you are performing service on or near the air bag system components or wiring. Please observe all WARNINGS and "Service Precautions" under "On-Vehicle Service" in air bag system section before performing service on or around the air bag system components or wiring. Failure to follow WARNINGS could result in unintentional activation of the system or could render the system inoperative. Either of these two conditions may result in severe injury.**
- **If the air bag system and another vehicle system both need repair, SUZUKI recommends that the air bag system be repaired first, to help avoid unintended air bag system activation.**
- **Do not modify the steering wheel, instrument panel or any other air bag system component on or around air bag system components or wiring. Modifications can adversely affect air bag system performance and lead to injury.**
- **If the vehicle will be exposed to temperatures over 93°C (200°F), for example, during a paint baking process, remove the air bag system components, that is air bag or inflator modules, SDM and/or seat belt with pretensioner, beforehand to avoid component damage or unintended activation.**

The circle with a slash in this manual means "Don't do this" or "Don't let this happen".

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FOREWORD

This SUPPLEMENTARY SERVICE MANUAL is a supplement to IGNIS (RG413) SERVICE MANUAL. It has been prepared exclusively for the following applicable model.

Applicable model: IGNIS (RG413/RG415) vehicles on and after the following vehicle identification numbers (VINs).

RG413 Type 2:

JSAFHV51S00130001
JSAFHX51S00130001
JSAFHX51S25130001
JSAFHX51S30130001
JSAFHX51S35130001
JSAFHY51S00130001
JSAFHY51S35130001
JSAFHY51S30130001
JS2HX51S☐35130001

RG413 Type 3:

JSAFHV51S00150001
JSAFHX51S00150001
JSAFHX51S25150001
JSAFHX51S30150001
JSAFHX51S35150001
JSAFHX51S45150001
JSAFHY51S00150001
JSAFHY51S30150001
JSAFHY51S35150001
JSAFHY51S45150001
JS2HX51S☐35150001

RG413 Type 4:

JSAFHV51S00170001
JSAFHX51S00170001
JSAFHX51S25170001
JSAFHX51S35170001
JSAFHX51S40170001
JSAFHX51S45170001
JSAFHY51S00170001
JSAFHY51S35170001
JSAFHY51S40170001
JSAFHY51S45170001
JS2HX51S☐45170001

RG415 (Sport model):

JSAFHV81S00100001

This supplementary service manual describes only different service information of the above applicable model as compared with IGINIS (RG413) SERVICE MANUAL. Therefore, whenever servicing the above applicable model, consult this supplement first. And for any section, item or description not found in this supplement, refer to the related manuals below.

When replacing parts or servicing by disassembling, it is recommended to use SUZUKI genuine parts, tools and service materials as specified in each description.

All information, illustrations and specifications contained in this literature are based on the latest product information available at the time of publication approval. And used as the main subject of description is the vehicle of standard specifications among others.
Therefore, note that illustrations may differ from the vehicle being actually serviced.
The right is reserved to make changes at any time without notice.

Related Manuals:

Manual Name	Manual No.
IGNIS (RG413) SERVICE MANUAL	99500-80G00-XXX
IGNIS (RG413/RG415) WIRING DIAGRAM MANUAL	99512-80G20-015

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NOTE:

For the screen toned sections in the above table, refer to the same section of Service Manual and Wiring Diagram Manual mentioned in FOREWORD of this manual.

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SECTION 0A

GENERAL INFORMATION

NOTE:

For the items with asterisk (*) in the "CONTENTS" below, refer to the same section of the Service Manual mentioned in "FOREWORD" of this manual.

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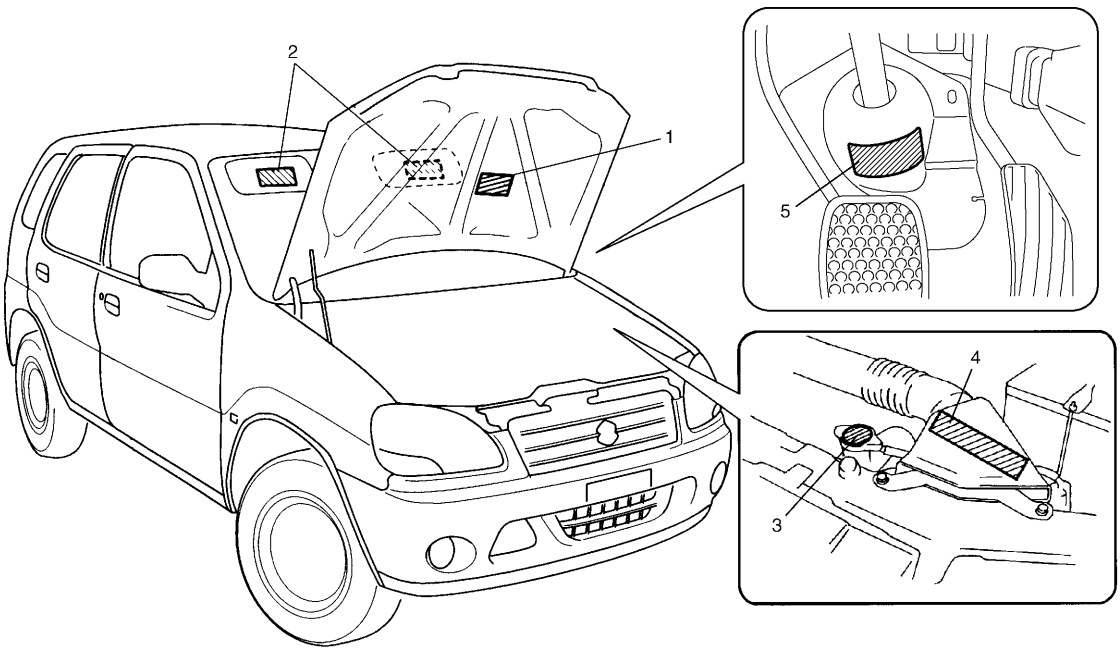
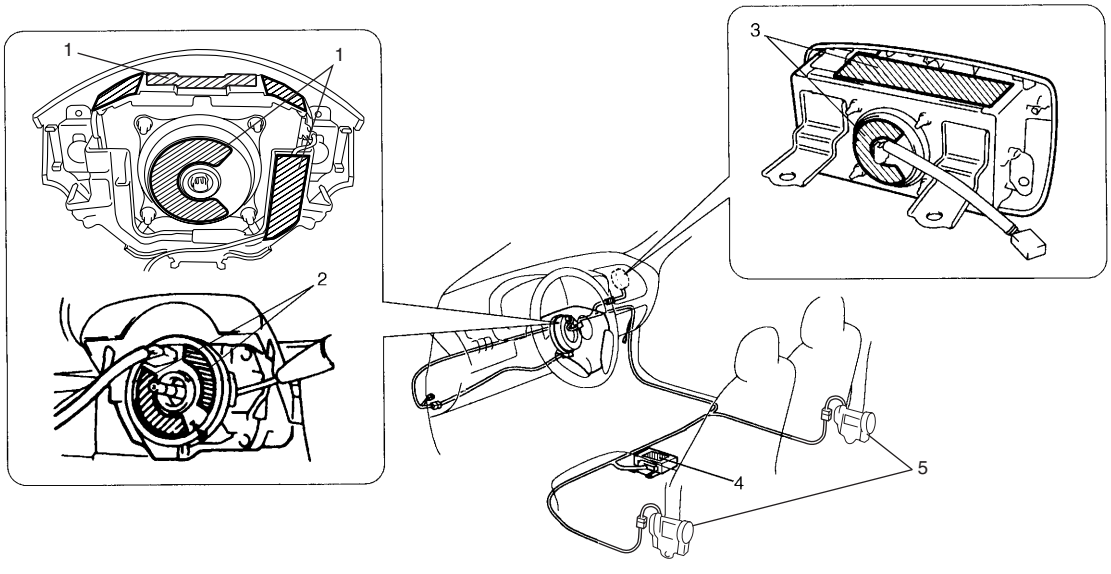
Warning, Caution and Information Labels

The figure below shows main labels among others that are attached to vehicle component parts.
When servicing and handling parts, refer to WARNING/CAUTION instructions printed on labels.
If any WARNING/CAUTION label is found stained or damaged, clean or replace it as necessary.



1. Air bag label on back side of engine hood (if equipped)	4. Engine cooling fan label
2. Air bag label on sun visor (if equipped)	5. Steering shaft label
3. Radiator cap label	

[A]



1. Air bag label on driver air bag (inflator) module	4. Air bag label on SDM
2. Air bag label on combination switch and contact coil assembly	5. Pretensioner label on seat belt retractor
3. Air bag label on passenger air bag (inflator) module	[A]: These labels are attached on vehicle equipped with air bag system only.

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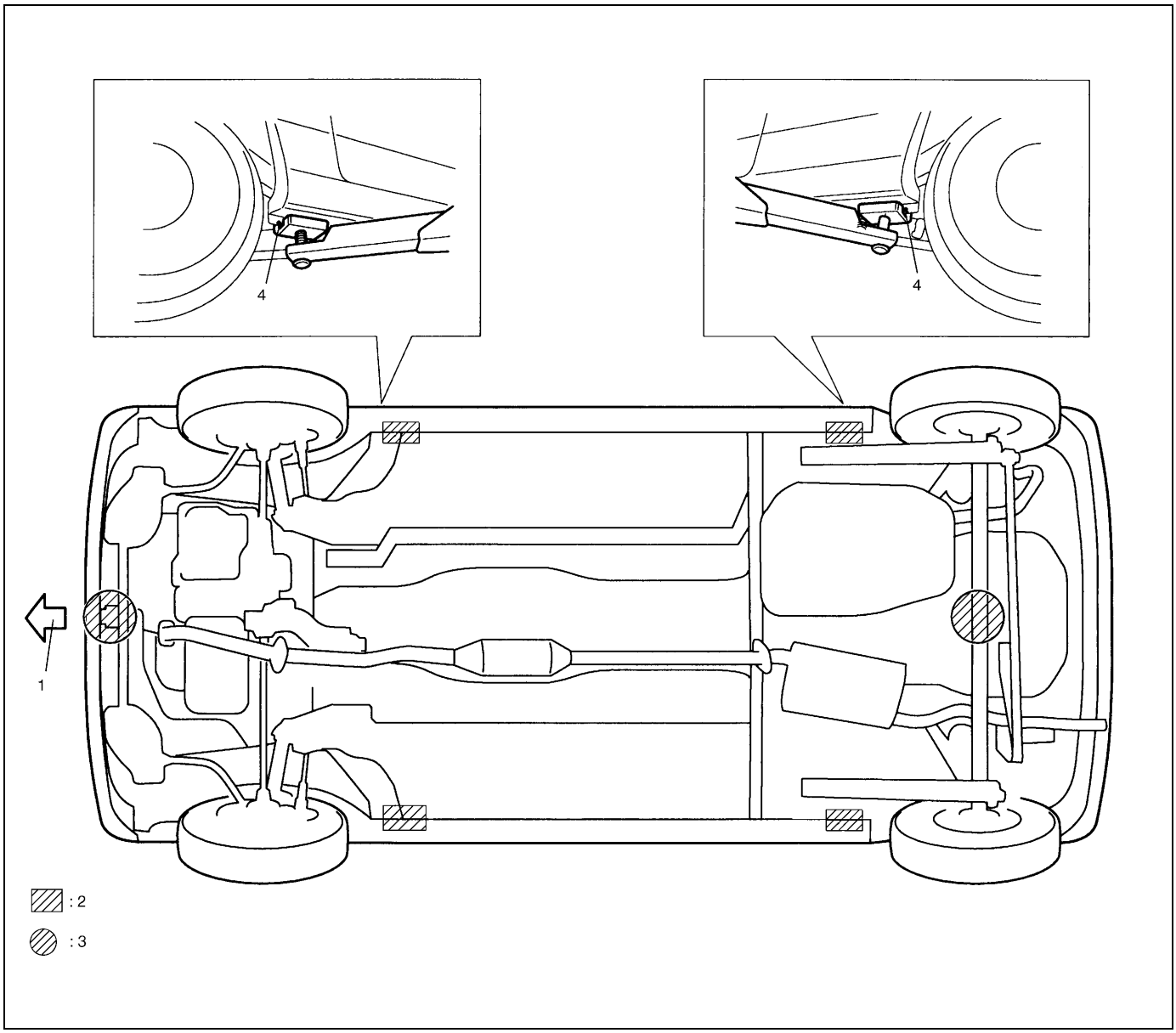
Vehicle Lifting Points

WARNING:

- **Before applying hoist to underbody, always take vehicle balance throughout service into consideration. Vehicle balance on hoist may change depending on what part to be removed.**
- **Before lifting up the vehicle, check to be sure that end of hoist arm is not in contact with brake pipe, fuel pipe, bracket or any other part.**
- **When using frame contact hoist, apply hoist as shown (right and left at the same position). Lift up the vehicle till 4 tires are a little off the ground and make sure that the vehicle will not fall off by trying to move vehicle body in both ways. Work can be started only after this confirmation.**
- **Make absolutely sure to lock hoist after vehicle is hoisted up.**

When Using Frame Contact Hoist



1.	Vehicle front
2.	Support position for frame contact hoist and safety stand
3.	Floor jack position
4.	Embossed-mark

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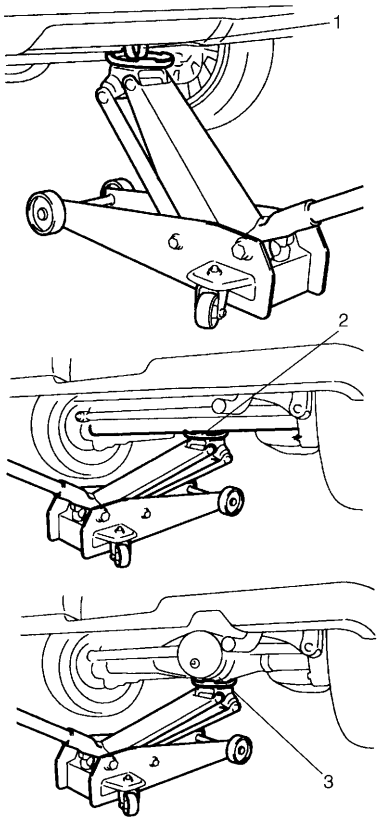
When Using Floor Jack



WARNING:

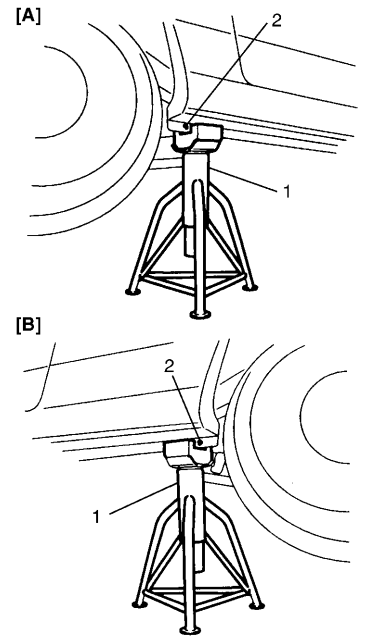
If the vehicle to be jacked up only at the front or rear end, be sure to block the wheels on ground in order to ensure safety.

After the vehicle is jacked up, be sure to support it on stands. It is extremely dangerous to do any work on the vehicle raised on jack alone.

CAUTION:

Never apply jack against suspension parts (i.e., stabilizer, etc) bumper or vehicle floor, or it may get deformed.

In raising front or rear vehicle end off the floor by jacking, be sure to put the jack against the front jacking bracket (1), the center portion of rear axle (2) (2WD vehicle) or rear axle housing (3) (4WD vehicle).



To perform service with either front or rear vehicle end jacked up, be sure to place safety stands (1) under vehicle body so that vehicle body is securely supported. And then check to ensure that vehicle body does not slide on safety stands (1) and the vehicle is held stable for safety's sake.

[A] : Front
[B] : Rear
2. Embossed mark

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Abbreviations and Symbols May Be Used in This Manual

Abbreviations

A	ABS	Anti-lock Brake System
	ATDC	After Top Dead Center
	API	American Petroleum Institute
	ATF	Automatic Transmission Fluid
	ALR	Automatic Locking Retractor
	AC	Alternating Current
	A/T	Automatic Transmission
	A/C	Air Conditioning
	ABDC	After Bottom Dead Center
	A/F	Air Fuel Mixture Ratio
	A-ELR	Automatic-Emergency Locking Retractor
B	B+	Battery Positive Voltage
	BTDC	Before Top Dead Center
	BBDC	Before Bottom Dead Center
C	CKT	Circuit
	CKP sensor	Crankshaft Position Sensor
	CMP sensor	Camshaft Position Sensor
	CO	Carbon Monoxide
	CPP switch	Clutch Pedal Position Switch (Clutch Switch, Clutch Start Switch)
	CPU	Central Processing Unit
	CRS	Child Restraint System
D	DC	Direct Current
	DLC	Data Link Connector (Assembly Line Diag. Link, ALDL, Serial Data Link, SDL)
	DOHC	Double Over Head Camshaft
	DOJ	Double Offset Joint
	DRL	Daytime Running Light
	DTC	Diagnostic Trouble Code (Diagnostic Code)
E	EBCM	Electronic Brake Control Module, ABS Control Module
	EBD	Electronic Brake Force Distribution
	ECM	Engine Control Module
	ECT sensor	Engine Coolant Temperature Sensor (Water Temp. Sensor, WTS)
	EGR	Exhaust Gas Recirculation
	EGRT sensor	EGR Temperature Sensor (Recirculated Exhaust Gas Temp. Sensor, REGTS)
	EFE Heater	Early Fuel Evaporation Heater (Positive Temperature Coefficient, PTC Heater)
E	EPS	Electronic Power Steering
	EVAP	Evaporative Emission
	EVAP Canister	Evaporative Emission Canister (Charcoal Canister)
F	4WD	4 Wheel Drive
G	GEN	Generator
	GND	Ground
H	HC	Hydrocarbons
	HO2S	Heated Oxygen Sensor
I	IAC Valve	Idle Air Control Valve (Idle Speed Control Solenoid Valve ISC Solenoid Valve)
	IAT Sensor	Intake Air Temperature Sensor (Air temperature Sensor, ATS)
	ICM	Immobilizer Control Module
	IG	Ignition
	ISC Actuator	Idle Speed Control Actuator
L	LH	Left Hand
	LSPV	Load Sensing Proportioning Valve
M	MAF Sensor	Mass Air Flow Sensor (Air Flow Sensor, AFS, Air Flow Meter, AFM)
	MAP Sensor	Manifold Absolute Pressure Sensor (Pressure Sensor, PS)
	Max	Maximum
	MFI	Multiport Fuel Injection (Multipoint Fuel Injection)
	MIN	Minimum
	MIL	Malfunction Indicator Lamp (“SERVICE ENGINE SOON” Light)
	M/T	Manual Transmission
N	NOx	Nitrogen Oxides
O	OBD	On-Board Diagnostic System (Self-Diagnosis Function)
	O/D	Overdrive
	OHC	Over Head Camshaft
	O2S	Oxygen Sensor
P	PNP	Park/Neutral Position
	P/S	Power Steering

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P	PSP Switch	Power Steering Pressure Switch (P/S Pressure Switch)
	PCM	Powertrain Control Module
	PCV	Positive Crankcase Ventilation
R	RH	Right Hand
S	SAE	Society of Automotive Engineers
	SDM	Sensing and Diagnostic Module (Air bag controller, Air bag control module)
	SFI	Sequential Multiport Fuel Injection
	SOHC	Single over Head Camshaft
T	TBI	Throttle Body Fuel Injection (Single-Point Fuel Injection, SPI)
	TCC	Torque Converter Clutch
	TCM	Transmission Control Module (A/T Controller, A/T Control Module)
	TP Sensor	Throttle Position Sensor
	TVV	Thermal Vacuum Valve (Thermal Vacuum Switching Valve, TVSV, Bimetal Vacuum Switching Valve, BVSV)
	TWC	Three Way Catalytic Converter (Three Way Catalyst)
	2WD	2 Wheel Drive
V	VIN	Vehicle Identification Number
	VSS	Vehicle Speed Sensor
	VVT	Variable Valve Timing
W	WU-OC	Warm Up Oxidation Catalytic Converter
	WU-TWC	Warm Up Three Way Catalytic Converter

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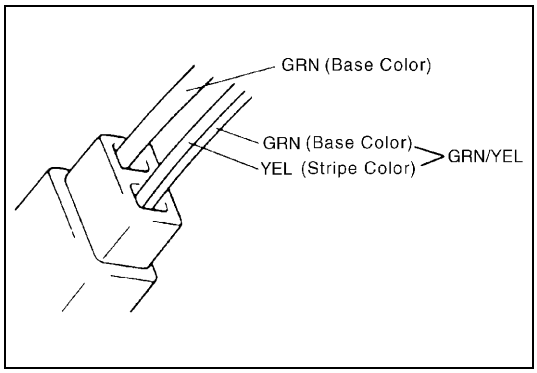
Symbols

SYMBOL	DEFINITION	SYMBOL	DEFINITION
	Tightening torque	1216B	Apply SUZUKI BOND NO. 1216B 99000-31230
OIL	Apply oil (engine, transmission, transfer, differential)	Si	Apply SILICONE SEALANT 99000-31120
FLD	Apply fluid (brake, power steering or automatic transmission fluid)	366E	Apply SEALING COMPOUND 366E 99000-31090
A	Apply SUZUKI SUPER GREASE A 99000-25010		
C	Apply SUZUKI SUPER GREASE C 99000-25030	1322	Apply THREAD LOCK 1322 99000-32110
E	Apply SUZUKI SUPER GREASE E 99000-25050	1333B	Apply THREAD LOCK 1333B 99000-32020
H	Apply SUZUKI SUPER GREASE H 99000-25120	1342	Apply THREAD LOCK 1342 99000-32050
I	Apply SUZUKI SUPER GREASE I 99000-25210		
1215	Apply SUZUKI BOND NO. 1215 99000-31110		Do not reuse
1207F	Apply SUZUKI BOND NO. 1207F 99000-31250		Note on reassembly

Wire Color Symbols

Symbol		Wire Color	Symbol		Wire Color
B	BLK	Black	O, Or	ORN	Orange
Bl	BLU	Blue	R	RED	Red
Br	BRN	Brown	W	WHT	White
G	GRN	Green	Y	YEL	Yellow
Gr	GRY	Gray	P	PNK	Pink
Lbl	LT BLU	Light blue	V	PPL	Violet
Lg	LT GRN	Light green			



There are two kinds of colored wire used in this vehicle. One is single-colored wire and the other is dual-colored (striped) wire.
The single-colored wire uses only one color symbol (i.e. “GRN”).
The dual-colored wire uses two color symbols (i.e. “GRN/YEL”).
The first symbol represents the base color of the wire (“GRN” in the figure) and the second symbol represents the color of the stripe (“YEL” in the figure).

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SECTION 0B

MAINTENANCE AND LUBRICATION

WARNING:

For vehicles equipped with a Supplemental Restraint (Air Bag) System:

- **Service on and around the air bag system components or wiring must be performed only by an authorized SUZUKI dealer. Refer to "Air Bag System Components and Wiring Location View" under "General Description" in air bag system section in order to confirm whether you are performing service on or near the air bag system components or wiring. Please observe all WARNINGS and "Service Precautions" under "On-Vehicle Service" in air bag system section before performing service on or around the air bag system components or wiring. Failure to follow WARNINGS could result in unintentional activation of the system or could render the system inoperative. Either of these two conditions may result in severe injury.**
- **Technical service work must be started at least 90 seconds after the ignition switch is turned to the "LOCK" position and the negative cable is disconnected from the battery. Otherwise, the system may be activated by reserve energy in the Sensing and Diagnostic Module (SDM).**

NOTE:

For the items with asterisk (*) in the "CONTENTS" below, refer to the same section of the Service Manual mentioned in "FOREWORD" of this manual.

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Maintenance Schedule

Maintenance Schedule Under Normal Driving Conditions

NOTE:

- **This interval should be judged by odometer reading or months, whichever comes first.**
- **This table includes service as scheduled up to 90,000 km (54,000 miles) mileage. Beyond 90,000 km (54,000 miles), carry out the same services at the same intervals respectively.**

Interval			Km (x 1,000)	15	30	45	60	75	90
			Miles (x 1,000)	9	18	27	36	45	54
			Months	12	24	36	48	60	72
ENGINE									
Drive belt				–	–	I	–	–	R
Valve lash (clearance)				–	I	–	I	–	I
Engine oil and oil filter				R	R	R	R	R	R
Engine coolant				–	–	R	–	–	R
Exhaust system				–	I	–	I	–	I
IGNITION SYSTEM									
✱Spark plugs	When unleaded fuel is used	Vehicle without HO2S	Nickel plug	–	R	–	R	–	R
			Iridium plug	–	–	–	R	–	–
		Vehicle with HO2S	Nickel plug	–	–	R	–	–	R
			Iridium plug	Replace every 105,000 km (63,000 miles) or 84 months					
	When leaded fuel is used, refer to “Maintenance Recommended Under Severe Driving Condition” in this section.								
FUEL SYSTEM									
Air cleaner filter			Paved-road	I	I	R	I	I	R
			Dusty conditions	Refer to “Maintenance Recommended Under Severe Driving Conditions” in this section.					
Fuel lines and connections				–	I	–	I	–	I
Fuel filter				Replace every 105,000 km (63,000 miles)					
Fuel tank				–	–	I	–	–	I
EMISSION CONTROL SYSTEM									
✱PCV valve		Vehicle without HO2S		–	–	I	–	–	I
		Vehicle with HO2S		–	–	–	–	–	I
✱Fuel evaporative emission control system				–	–	–	–	–	I

NOTE:

- **“R” : Replace or change**
- **“I” : Inspect and correct, replace or lubricate if necessary**
- **For Sweden, items with ✱ (asterisk) should be performed by odometer reading only.**
- **For spark plugs, replace every 50,000 km if the local law requires.**
- **Nickel spark plug: BKR6E-11 (NGK) or K20PR-U11 (DENSO)**
- **Iridium spark plug: IFR6J11 (NGK)**

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Interval	Km (x 1,000)	15	30	45	60	75	90
	Miles (x 1,000)	9	18	27	36	45	54
	Months	12	24	36	48	60	72
BRAKE							
Brake discs and pads (thickness, wear, damage)		I	I	I	I	I	I
Brake drums and shoes (wear, damage)		–	I	–	I	–	I
Brake hoses and pipes (leakage, damage, clamp)		–	I	–	I	–	I
Brake fluid		–	R	–	R	–	R
Brake lever and cable (damage, stroke, operation)		Inspect at first 15,000 km (9,000 miles only)					
CHASSIS AND BODY							
Clutch (pedal height and travel)		–	I	–	I	–	I
Tires (wear, damage, rotation) /wheels (damage)		I	I	I	I	I	I
Suspension system (tightness, damage, rattle, breakage)		–	I	–	I	–	I
Steering system (tightness, damage, breakage, rattle)		–	I	–	I	–	I
Drive shaft (axle) boots/Propeller shafts (4WD)		–	–	I	–	–	I
Manual transmission oil (leakage, level) (I : 1st 15,000 km only)		I	–	R	–	–	R
Automatic transmission fluid	Fluid level	–	I	–	I	–	I
	Fluid change	Replace every 165,000 km (99,000 miles)					
Transfer oil (4WD) (leakage, level)		I	–	I	–	I	–
Rear differential oil (4WD) (leakage, level) (R : 1st 15,000 km only)		R or I	–	I	–	I	–
All latches, hinges and locks		–	I	–	I	–	I

NOTE:

- **"R" : Replace or change**
- **"I" : Inspect and correct or replace if necessary**

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Maintenance Recommended Under Severe Driving Conditions

If the vehicle is usually used under the conditions corresponding to any severe condition code given below, IT IS RECOMMENDED that applicable maintenance operation be performed at the particular interval as shown in the following table.

Severe condition code:
A: Repeated short trips
B: Driving on rough and/or muddy roads
C: Driving on dusty roads
D: Driving in extremely cold weather and/or salted roads
E: Repeated short trips in extremely cold weather
F: Leaded fuel use
G: – – – – –
H: Towing a trailer (if admitted)

Severe Condition Code	Maintenance		Maintenance Operation	Maintenance Interval
– B C D – – – –	Drive belt		I	Every 15,000 km (9,000 miles) or 12 months
			R	Every 45,000 km (27,000 miles) or 36 months
A – C D E F – H	Engine oil and oil filter		R	Every 5,000 km (3,000 miles) or 4 months
– – C – – – – –	Air cleaner filter ✱1		I	Every 2,500 km (1,500 miles)
			R	Every 30,000 km (18,000 miles) or 24 months
A B C – E F – H	Spark plugs	Nickel spark plug	R	Every 10,000 km (6,000 miles) or 8 months
		Iridium spark plug	R	Every 30,000 km (18,000 miles) or 24 months
– B C D – – – H	Wheel bearings		I	Every 15,000 km (9,000 miles) or 12 months
– B – D E – – H	Drive shafts and propeller shafts (4WD)		I	Every 15,000 km (9,000 miles) or 12 months
– B – – E – – H	Manual transmission oil/Transfer oil (4WD A/T)/Differential oil (4WD)		R	First time only: 15,000 km (9,000 miles) or 12 months
			R	Second time and after: Every 30,000 km (18,000 miles) or 24 months reckoning from 0 km (0 mile) or 0 month
– B – – E – – H	Automatic transmission fluid		R	Every 30,000 km (18,000 miles) or 24 months

NOTE:

- **"I" : Inspect and correct or replace if necessary**
- **"R" : Replace or change**
- **✱1: Inspect more frequently if the vehicle is used under dusty conditions.**

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Maintenance Service

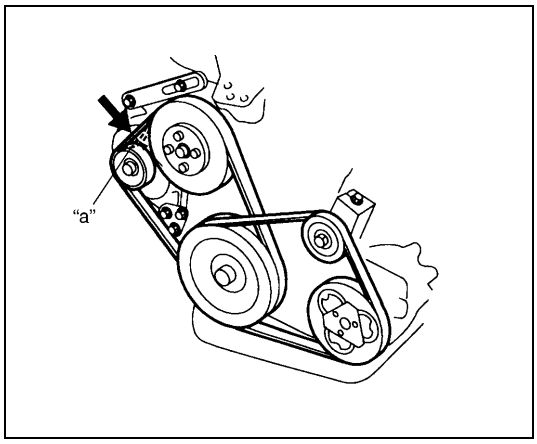
Engine

Drive belt

WARNING:
All inspection and replacement are to be performed with ENGINE NOT RUNNING.

Water Pump and Generator Drive Belt Inspection

1) Disconnect negative (–) cable at battery.



2) Inspect belt for cracks, cuts, deformation, wear and cleanliness. If any defect exists, replace.
   Check belt for tension.

   Water pump and generator belt tension
   "a" : 4.5 - 5.5 mm (0.18 - 0.22 in.) deflection under 100 N (10 kg, 22 lb) pressure

   NOTE:
   When replacing belt with a new one, adjust belt tension to 3 - 4 mm (0.12 - 0.16 in.)

3) If belt is too tight or too loose, adjust it to specification by adjusting alternator position.
4) Tighten alternator adjusting bolts and pivot bolt.
5) Connect negative (–) cable to battery.

Water Pump and Generator Drive Belt Replacement

Replace belt with new one referring to "Water Pump / Generator Drive Belt" in Section 6B.

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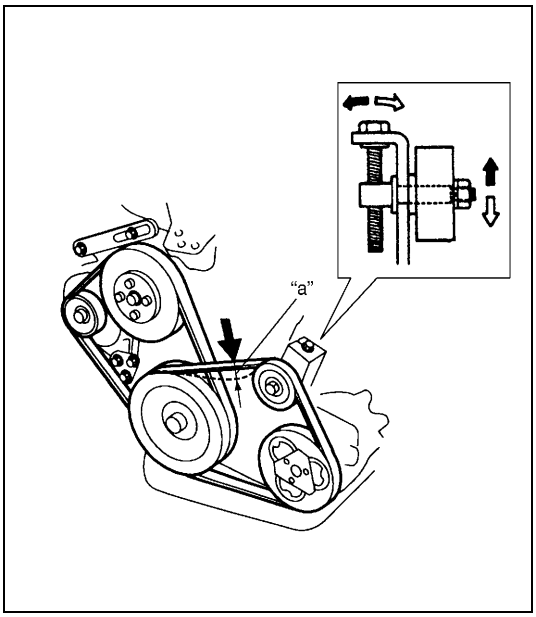
A/C Compressor Drive Belt (If Equipped) Inspection

1) Disconnect negative (–) cable at battery.



2) Inspect belt for cracks, cuts, deformation, wear and cleanliness. If any defect exists, replace.
   Check belt for tension.
   If belt tension is out of specification, adjust it referring to "Compressor Drive Belt" in Section 1B.

A/C compressor drive belt tension
"a" : 3 - 5 mm (0.12 - 0.20 in.) deflection under 100 N (10 kg, 22 lb) pressure

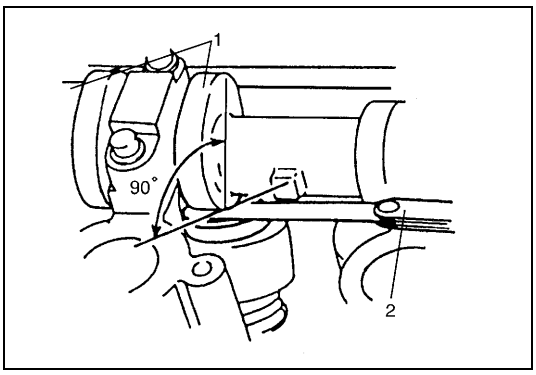
3) Connect negative (–) cable to battery.

Replacement

Replace belt with new one referring to "Compressor Drive Belt" in Section 1B.

Valve lash (clearance)

Inspection



1) Inspect intake and exhaust valve lash and adjust as necessary.
   Refer to "Valve Lash (Clearance)" in Section 6A1 or "Valve Lash (Clearance) Inspection" in Section 6A2 for valve lash inspection and adjustment procedure.

1.	Camshaft
2.	Thickness gauge

Engine oil and oil filter

Replacement

WARNING:
- **New and used engine oil can be hazardous. Be sure to read "WARNING" in General Precaution in Section 0A and observe what in written there.**
- **Step 1) - 7) outlined below must be performed with ENGINE NOT RUNNING. For step 8), be sure to have adequate ventilation while engine is running.**

Before draining engine oil, check engine for oil leakage. If any evidence of leakage is found, make sure to correct defective part before proceeding to the following work.

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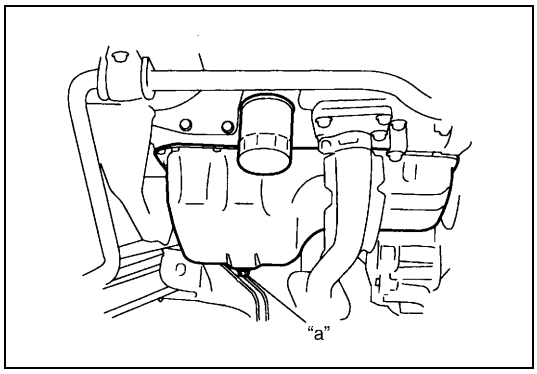
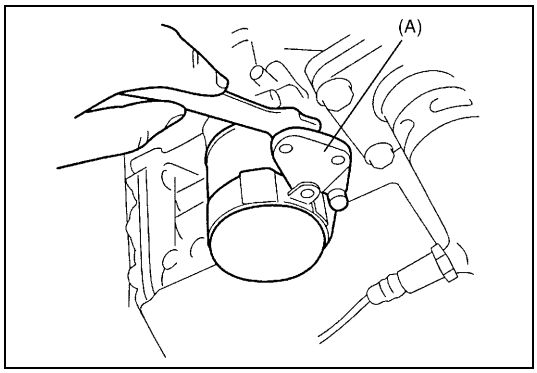


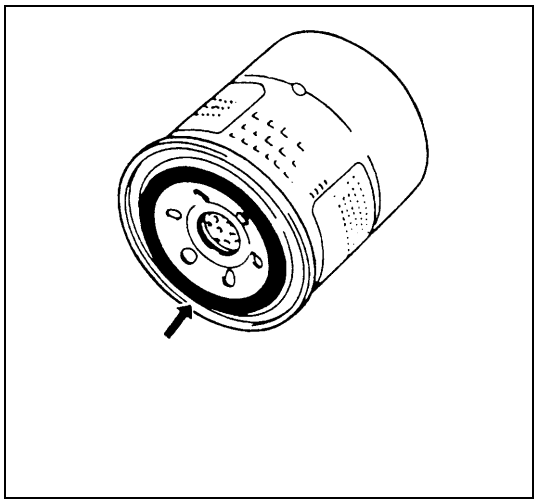
1) Drain engine oil by removing drain plug.
2) After draining oil, wipe drain plug clean. Reinstall drain plug, and tighten it securely as specified below.

Tightening torque
Engine oil drain plug (a) : 50 N·m (5.0 kg-m, 36.5 lb-ft)



3) Loosen oil filter by using oil filter wrench (special tool).

Special tool
(A) : 09915-47330



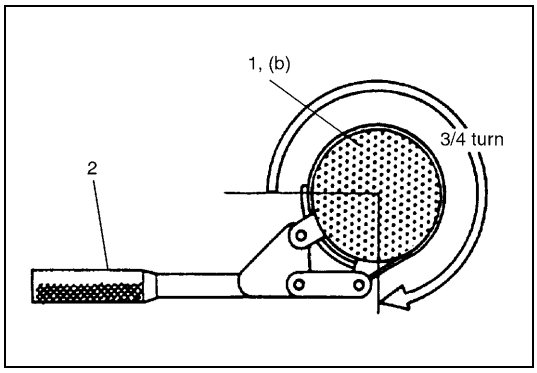
NOTE:

Before fitting new oil filter, be sure to oil its O-ring. Use engine oil for this purpose.

4) Screw new filter on oil filter stand by hand until the filter O-ring contacts the mounting surface.

CAUTION:

To tighten oil filter properly, it is important to accurately identify the position at which filter O-ring first contacts the mounting surface.



5) Tighten the filter (1) 3/4 turn from the point of contact with the mounting surface using an oil filter wrench (2).

Tightening torque
Oil filter (b) : 14 N·m (1.4 kg-m, 10.5 lb-ft) (for reference)

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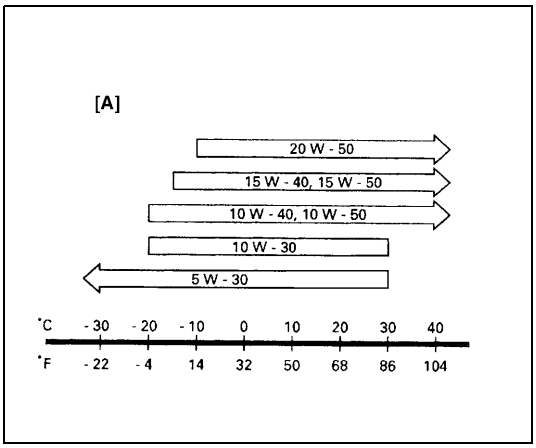


6) Replenish oil until oil level is brought to FULL level mark on dipstick. (oil pan and oil filter capacity). The filler inlet is at the top of the cylinder head cover.
   It is recommended to use engine oil of SE, SF, SG, SH, SJ or SL grade. Select the appropriate oil viscosity according to the proper engine oil viscosity chart [A].

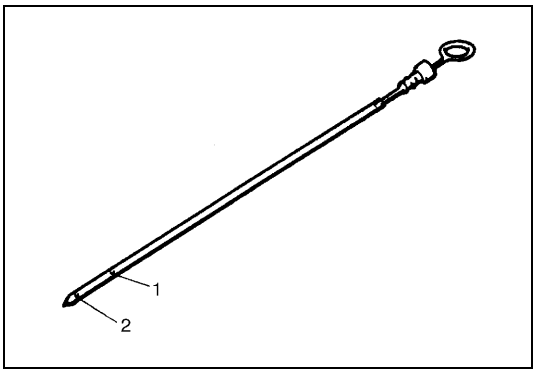
Engine oil specification

Oil pan capacity	About 3.6 liters (7.6/6.3 US/Imp pt.)
Oil filter capacity	About 0.2 liter (0.4/0.3 US/Imp pt.)
Others	About 0.3 liter (0.6/0.5 US/Imp pt.)
Total	About 4.1 liters (8.7/7.2 US/Imp pt.)

NOTE:

Engine oil capacity is specified. However, note that the amount of oil required when actually changing oil may somewhat differ from the data in the table depending on various conditions (temperature, viscosity, etc.)

7) Check oil filter and drain plug for oil leakage.



8) Start engine and run it for 3 minutes. Stop it and wait 5 minutes before checking oil level. Add oil, as necessary, to bring oil level to FULL level mark on dipstick.

1. Full level mark (hole)
2. Low level mark (hole)

Engine coolant

Replacement

WARNING:

To help avoid danger of being burned, do not remove radiator cap while engine and radiator are still hot. Scalding fluid and steam can be blown out under pressure if cap is taken off too soon.

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CAUTION:

When changing engine coolant, use mixture of 50% specified water and 50% ANTIFREEZE / ANTICORROSION COOLANT for the purpose of corrosion protection and lubrication.

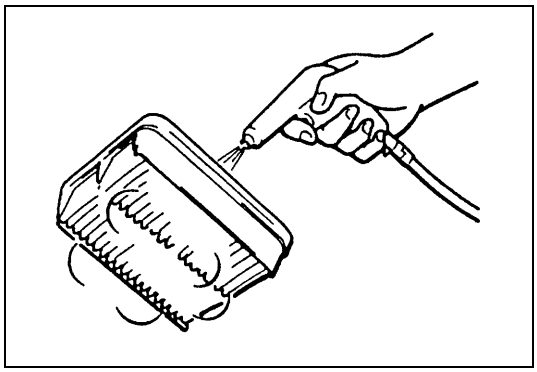
Change engine coolant with new one referring to “Cooling System Flush and Refill” in Section 6B.

Fuel System

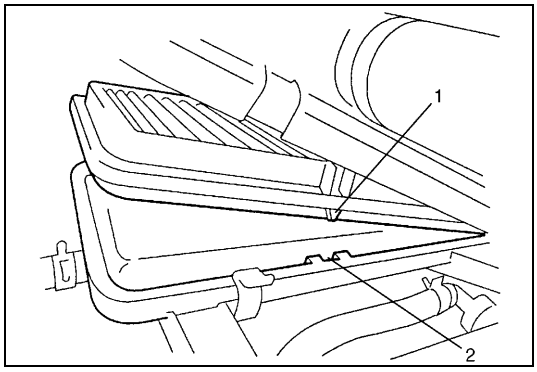
Air cleaner filter

Inspection

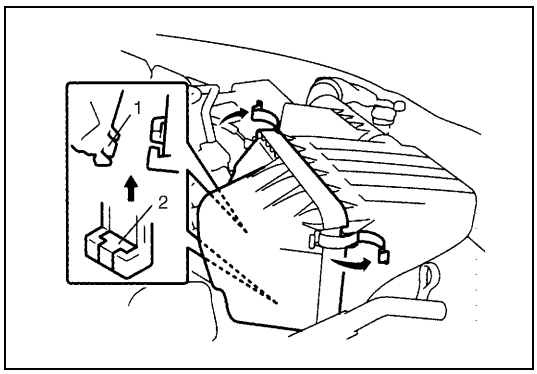
1) Remove air cleaner case clamps.
2) Take air cleaner filter out of case.



3) Check that filter is not excessively dirty, damaged or oily, clean filter with compressed air from air outlet side of filter.



4) For M13 engine:
   Install air cleaner filter fitting protrusion (1) of filter into groove (2) of case and clamp upper case securely.



- For M15 engine:
  Install air cleaner filter and then case cap by inserting cap tab (1) into case groove (2). Clamp cap securely.

Replacement

Replace air cleaner filter with new one according to steps 1), 2) and 4) of inspection procedure.

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Emission Control System

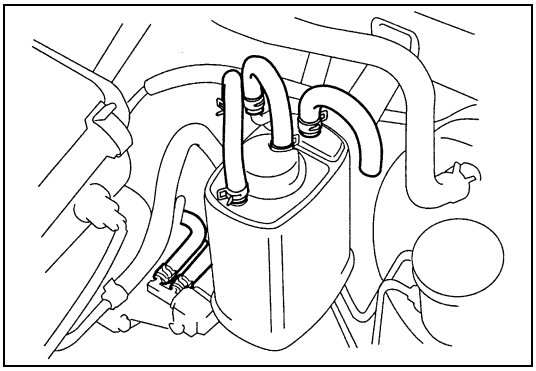
PCV valve

Inspection

Check crankcase ventilation hose and PCV hose for leaks, cracks or clog, and PCV valve for stick or clog. Refer to “PCV System” of Section 6E1 or “PCV system inspection” in Section 6E2 for PCV valve checking procedure.

Fuel evaporative emission control system

Inspection



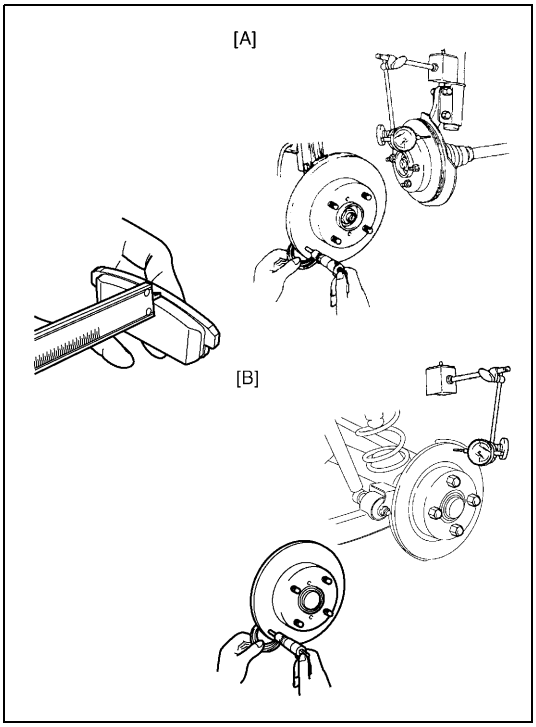
1) Visually inspect hoses for cracks, damage, or excessive bends. Inspect all clamps for damage and proper position.
2) Check EVAP canister for operation and clog, referring to “EVAP Control System” in Section 6E1 or “Evaporative emission control system inspection” in Section 6E2.

If a malfunction is found, repair or replace.

Brake

Brake discs and pads

Inspection



1) Remove wheel and caliper but don’t disconnect brake hose from caliper.
2) Check disc brake pads and discs for excessive wear, damage and deflection. Replace parts as necessary. For details, refer to “Front Brake” and “Rear Brake (Sport Model)” in Section 5.
   Be sure to torque caliper pin bolts to specification.

[A]:	Front brake
[B]:	Rear brake (sport model)

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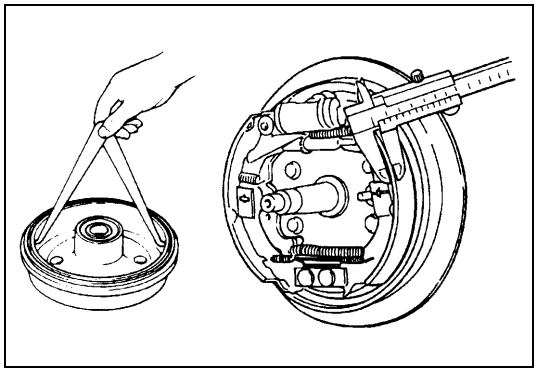
Brake drums and shoes

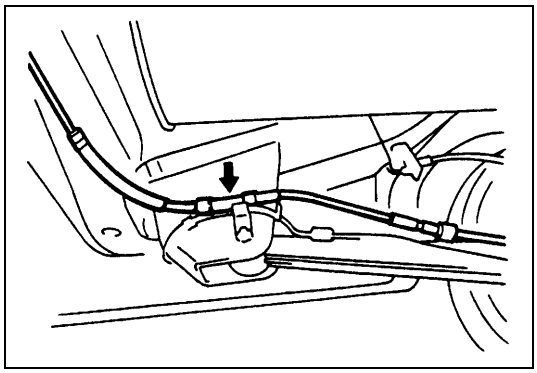
Inspection



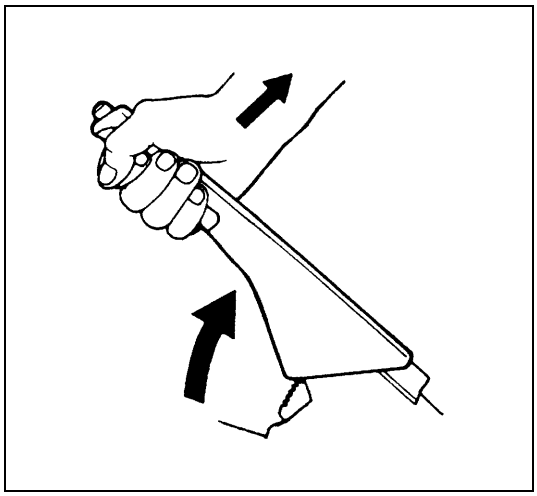
1) Remove wheel and brake drum.
2) Check rear brake drums and brake linings for excessive wear and damage, while wheels and drums are removed. At the same time, check wheel cylinders for leaks. Replace these parts as necessary.
   For details, refer to “Rear Brake (Except Sport Model)” in Section 5.

Brake lever and cable

Inspection



1) Inspect brake cable for damage and smooth movement. Replace cable if it is in deteriorated condition.



2) Check tooth tip of each notch for damage or wear. If any damage or wear is found, replace parking lever.
3) Check parking brake lever for proper operation and stroke, and adjust it if necessary.
   For checking and adjusting procedures, refer to “Parking Brake Inspection and Adjustment” in Section 5.

Parking brake lever stroke:
4 to 9 notches (When lever is pulled up at 200 N (20 kg, 44 lbs) ····· Except sport model)
5 to 10 notches (When lever is pulled up at 150 N (15 kg, 33 lbs) ····· Sport model)

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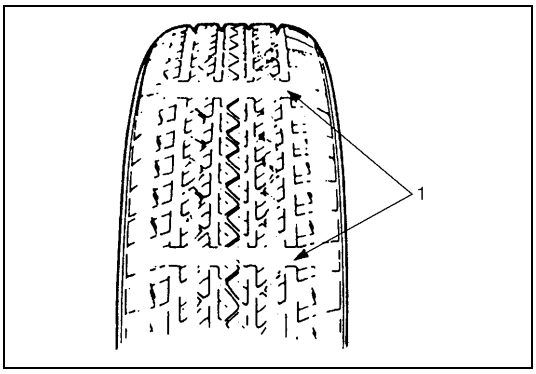
Chassis and Body

Tires / wheels

Tires Inspection



1) Check tires for uneven or excessive wear, or damage.
   If defective, replace.
   Refer to “Tire Diagnosis” in Section 3 for details.

1. Wear indicator

2) Check inflating pressure of each tire and adjust pressure to specification as necessary.

NOTE:

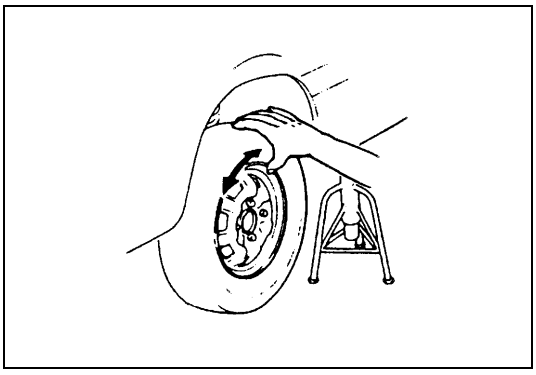
- **Tire inflation pressure should be checked when tires are cool.**
- **Specified tire inflation pressure should be found on tire placard or in owner’s manual which came with the vehicle.**

3) Rotate tires.
   For details, refer to “Tire Rotation (Except Sport Model)” or “Tire Rotation (Sport Model)” in Section 3F.

Wheel Discs Inspection

Inspect each wheel disc for dents, distortion and cracks. A disc in badly damaged condition must be replaced.

Wheel Bearing Inspection



1) Check front wheel bearing for wear, damage, abnormal noise or rattles. For details, refer to “Wheel Disc, Nut and Bearing Check” in Section 3D.
2) Check rear wheel bearing for wear, damage, abnormal noise or rattles. For details, refer to “Wheel Disc, Nut and Bearing Check” in Section 3E.

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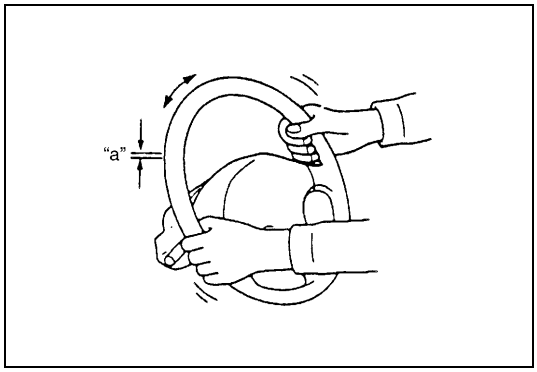
Steering system

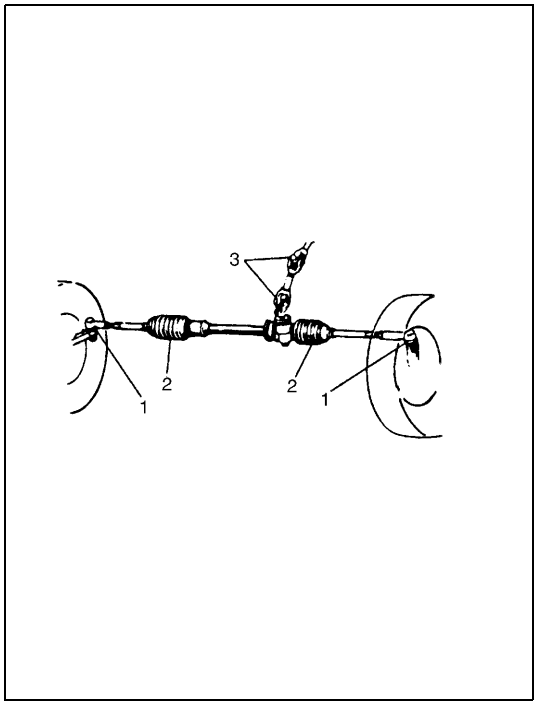
Inspection



1) Check steering wheel for play and rattle, holding vehicle straight on ground.

Steering wheel play
"a": 0 – 30 mm (0 – 1.1 in.)

2) Check bolts and nuts for tightness and retighten them as necessary. Repair or replace defective parts, if any.



3) Check steering linkage for looseness and damage. Repair or replace defective parts, if any.
4) Check boots (1) and (2) of steering linkage and steering gear case for damage (leak, detachment, tear, etc.). If damage is found, replace defective boot with new one.
   If any dent is found on steering gear case boots, correct it to original shape by turning steering wheel to the right or left as far as it stops and holding it for a few seconds.
5) Check universal joints (3) of steering shaft for rattle and damage. If rattle or damage is found, replace defective part with a new one.
6) Check that steering wheel can be turned fully to the right and left. Repair or replace defective parts, if any.
7) If equipped with power steering system, check also, in addition to above check items, that steering wheel can be turned fully to the right and left more lightly when engine is running at idle speed than when it is stopped. Repair, if found faulty.
8) Check wheel alignment referring to Section 3A.

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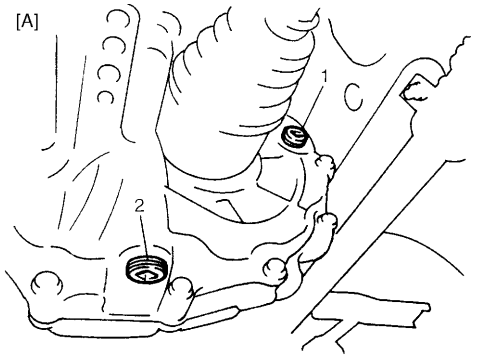
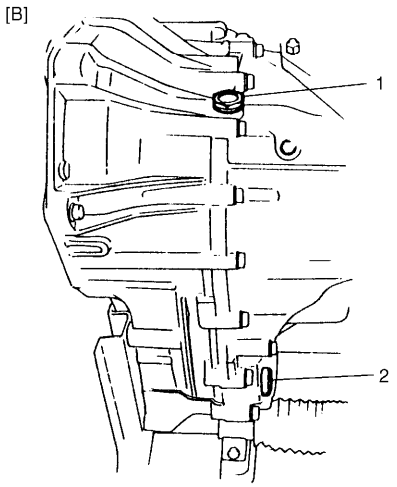
Manual transmission oil

Inspection





1) Inspect transmission case for evidence of oil leakage. Repair leaky point if any.
2) Make sure that vehicle is placed level for oil level check.
3) Remove oil filler/level plug (1) of transmission.
4) Check oil level.
   Oil level can be checked roughly by means of filler/level plug hole. That is, if oil flows out of level plug hole or if oil level is found up to hole when level plug is removed, oil is properly filled.
   If oil is found insufficient, pour specified oil up to level hole.
   For specified oil, refer to “Manual Transmission Oil Change” in Section 7A or 7A1.
5) Apply sealant to filler/level plug and tighten it to specified torque.

[A]: M13 engine
[B]: M15 engine

Replacement

1) Place the vehicle level and drain oil by removing drain plug (2).
2) Apply sealant to drain plug after cleaning it and tighten drain plug to specified torque.
3) Pour specified oil up to level hole.
4) Tighten filler plug to specified torque.
   For recommended oil, its amount and tightening torque data, refer to “Manual Transmission Oil Change” in Section 7A or 7A1.

Recommended Fluids and Lubricants

Engine oil	SE, SF, SG, SH, SJ or SL grade (Refer to “Engine Oil and Oil Filter” in this section for engine oil viscosity.)
Engine coolant (Ethylene glycol base coolant)	“Antifreeze/Anticorrosion coolant”
Brake fluid	DOT 3
Manual transmission oil	Refer to “Manual Transaxle Oil Change” in Section 7A or 7A1.
Transfer oil (4WD)	Refer to “Transfer Oil Change” in Section 7D.
Differential oil (4WD)	Refer to “Differential Oil Change” in Section 7F.
Automatic transmission fluid	An equivalent of DEXRON®-III
Door hinges	Engine oil or water resistance chassis grease
Hood latch assembly	Engine oil or water resistance chassis grease
Key lock cylinder	Spray lubricant

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SECTION 1B

AIR CONDITIONING (OPTIONAL)

WARNING:

For vehicles equipped with a Supplemental Restraint (Air Bag) System:

- **Service on and around the air bag system components or wiring must be performed only by an authorized SUZUKI dealer. Refer to "Air Bag System Components and Wiring Location View" under "General Description" in air bag system section in order to confirm whether you are performing service on or near the air bag system components or wiring. Please observe all WARNINGs and "Service Precautions" under "On-Vehicle Service" in air bag system section before performing service on or around the air bag system components or wiring. Failure to follow WARNINGs could result in unintentional activation of the system or could render the system inoperative. Either of these two conditions may result in severe injury.**
- **Technical service work must be started at least 90 seconds after the ignition switch is turned to the "LOCK" position and the negative cable is disconnected from the battery. Otherwise, the system may be activated by reserve energy in the Sensing and Diagnostic Module (SDM).**

CAUTION:

The air conditioning system of this vehicle uses refrigerant HFC-134a (R-134a).
None of refrigerant, compressor oil and component parts is interchangeable between two types of A/C : one using refrigerant HFC-134a (R-134a) and the other using refrigerant CFC-12 (R-12).
Be sure to check which refrigerant is used before any service work including inspection and maintenance. For identification between these two types, refer to "REFRIGERANT TYPE" in this section.
When replenishing or changing refrigerant and compressor oil and when replacing parts, make sure that the material or the part to be used is appropriate to the A/C installed in the vehicle being serviced. Use of incorrect one will result in leakage of refrigerant, damage in parts or other faulty condition.

NOTE:

For the items with asterisk (*) in the "CONTENTS" below, refer to the same section of the Service Manual mentioned in "FOREWORD" of this manual.

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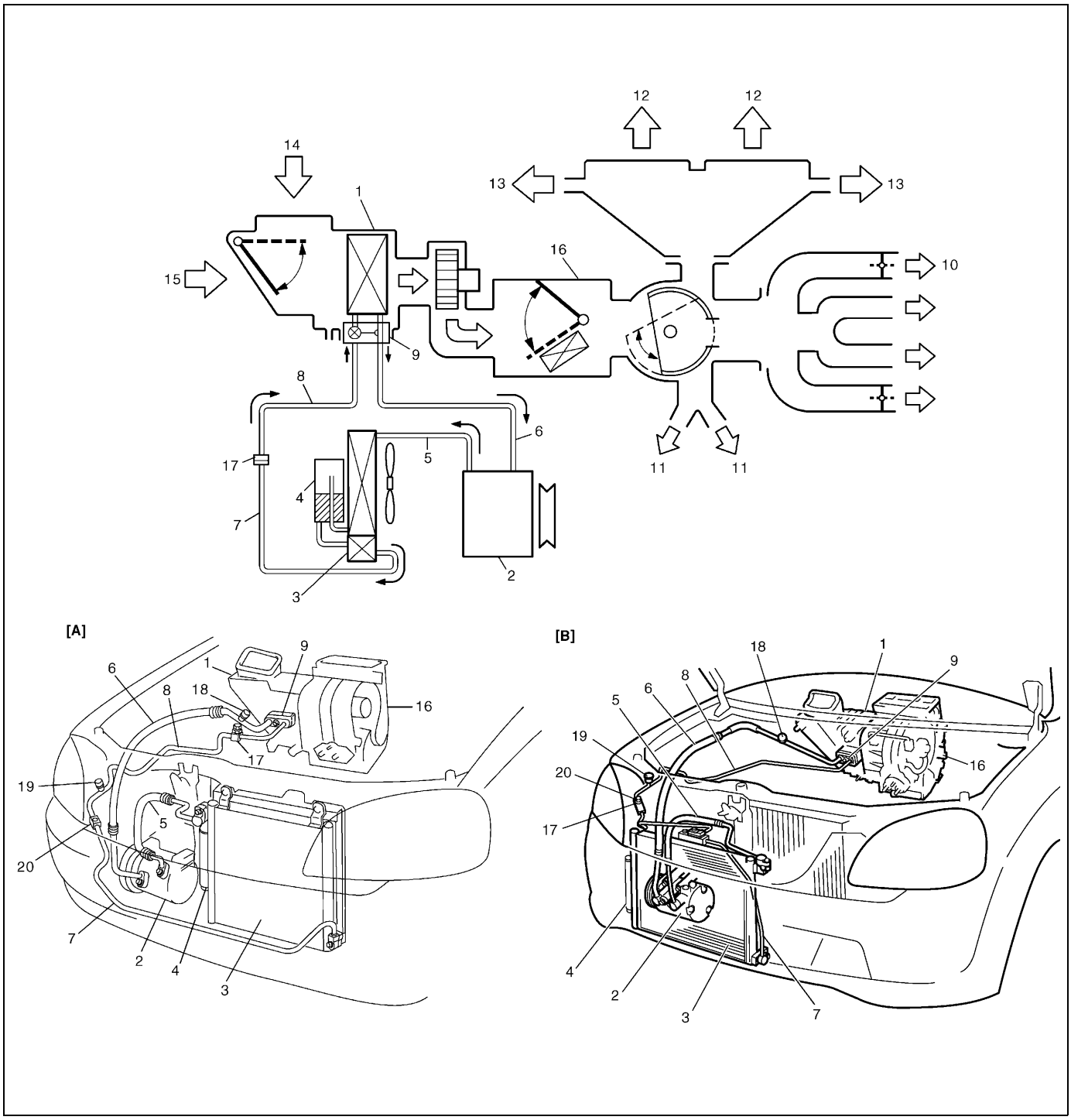
General Description

Major Components and Location



[A]: Except sport model	5. Discharge hose	11. Foot air	17. A/C refrigerant pressure switch
[B]: Sport model	6. Suction pipe	12. Defroster air	18. Low pressure charge valve
1. Cooling unit	7. Condenser outlet pipe	13. Demister air	19. High pressure charge valve
2. Compressor	8. Liquid pipe	14. Fresh air	20. Sight glass
3. Condenser assembly	9. Expansion valve	15. Recirculation air	
4. Receiver/dryer	10. Ventilation air	16. Heater unit	

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Diagnosis

General Diagnosis Table

Condition	Possible Cause	Correction
Cool air doesn't come out (A/C system doesn't operate)	No refrigerant	Perform recover, evacuation and charging.
	Fuse blown	Check fuses in circuit fuse and main fuse boxes, and check short circuit to ground.
	A/C switch faulty	Check A/C switch.
	Blower fan switch faulty	Check blower fan switch referring to "Heater Control Assembly" in Section 1A.
	A/C evaporator temperature sensor faulty	Check A/C evaporator temperature sensor.
	A/C refrigerant pressure switch faulty	Check A/C refrigerant pressure switch.
	Wiring or grounding faulty	Repair as necessary.
	ECT sensor faulty	Check ECT sensor referring to "Engine coolant temperature sensor (ECT sensor)" in Section 6E1 or 6E2.
	ECM and its circuit faulty	Check ECM and its circuit referring to "A/C System Inspection of ECM and Its Circuits" in this section and "Table B-5 A/C Signal Circuit Check (Vehicle with A/C)" in Section 6 or 6-1.
Cool air doesn't come out (A/C compressor doesn't operate)	ECM and its circuit faulty	Check ECM and its circuit referring to "A/C System Inspection of ECM and Its Circuits" in this section and "Table B-5 A/C Signal Circuit Check (Vehicle with A/C)" in Section 6 or 6-1.
	Magnet clutch faulty	Check magnet clutch.
	Compressor drive belt loosen or broken	Adjust or replace drive belt.
	Compressor faulty	Check compressor.
	Compressor thermal switch faulty	Check compressor thermal switch.
Cool air doesn't come out (A/C condenser cooling fan motor doesn't operate)	Fuse blown	Check fuses in circuit fuse and main fuse boxes, and check short circuit to ground.
	Wiring or grounding faulty	Repair as necessary.
	Radiator/condenser cooling fan motor relay (except sport model) or condenser cooling fan motor relay faulty (sport model)	Check radiator/condenser cooling fan motor relay No.1, No.2 and No.3 (except sport model) or condenser cooling fan relay (sport model).
	Radiator/condenser cooling fan motor (except sport model) or condenser cooling fan motor faulty (sport model)	Check radiator/condenser cooling fan motor (except sport model) or condenser cooling fan motor (sport model).
	ECM and its circuit faulty	Check ECM and its circuit referring to "A/C System Inspection of ECM and Its Circuits" in this section and "Table B-5 A/C Signal Circuit Check (Vehicle with A/C)" in Section 6 or 6-1.

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Condition	Possible Cause	Correction
Cool air doesn't come out (Blower fan motor doesn't operate)	Fuse blown	Check "HTR" fuse in circuit fuse box and main fuses, and check short circuit to ground.
	Blower fan motor resistor faulty	Check blower fan motor resistor referring to Section 1A.
	Blower fan switch faulty	Check blower fan switch referring to "Blower Fan Motor Resistor" in Section 1A.
	Wiring or grounding faulty	Repair as necessary.
	Blower fan motor faulty	Check blower fan motor referring to "Blower Fan Motor" in Section 1A.
Cool air doesn't come out or insufficient cooling (A/C system normal operation)	Insufficient or excessive charge of refrigerant	Check charge of refrigerant and system for leaks.
	Condenser clogged	Check condenser.
	A/C evaporator clogged or frosted	Check A/C evaporator and A/C evaporator temperature sensor.
	A/C evaporator temperature sensor faulty	Check A/C evaporator temperature sensor.
	Expansion valve faulty	Check expansion valve.
	Receiver/dryer clogged	Check receiver/dryer.
	Compressor drive belt loosen or broken	Adjust or replace drive belt.
	Magnetic clutch faulty	Check magnetic clutch.
	Compressor faulty	Check compressor.
	Air in A/C system	Replace dryer, and perform evacuation and charging.
	Air leaking from cooling unit or air duct	Repair as necessary.
	Heater and ventilation system faulty	Check air inlet box (cooling unit), heater control assembly and heater unit referring to "Heater Unit" in Section 1A.
	Blower fan motor faulty	Check blower fan motor referring to "Blower Fan Motor" in Section 1A.
	Excessive compressor oil existing in A/C system	Pull out compressor oil in A/C system circuit, and check compressor.
Cool air doesn't come out only intermittently	Wiring connection faulty	Repair as necessary.
	Expansion valve faulty	Check expansion valve.
	Excessive moisture in A/C system	Replace dryer, and perform evacuation and charging.
	Magnetic clutch faulty	Check magnetic clutch.
	Excessive charge of refrigerant	Check charge of refrigerant.
Cool air comes out only at high speed	Condenser clogged	Check condenser.
	Insufficient charge of refrigerant	Check charge of refrigerant.
	Air in A/C system	Replace dryer, and perform evacuation and charging.
	Compressor drive belt loosen or broken	Adjust or replace drive belt.
	Compressor faulty	Check compressor.
Cool air doesn't come out only at high speed	Excessive charge of refrigerant	Check charge of refrigerant.
	A/C evaporator frosted	Check A/C evaporator and A/C evaporator temperature sensor.

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Condition	Possible Cause	Correction
Insufficient velocity of cooled air	A/C evaporator clogged or frosted	Check A/C evaporator and A/C evaporator temperature sensor.
	Air leaking from cooling unit or air duct	Repair as necessary.
	Blower fan motor faulty	Check blower fan motor referring to “Blower Fan Motor” in Section 1A.
	Wiring or grounding faulty	Repair as necessary.

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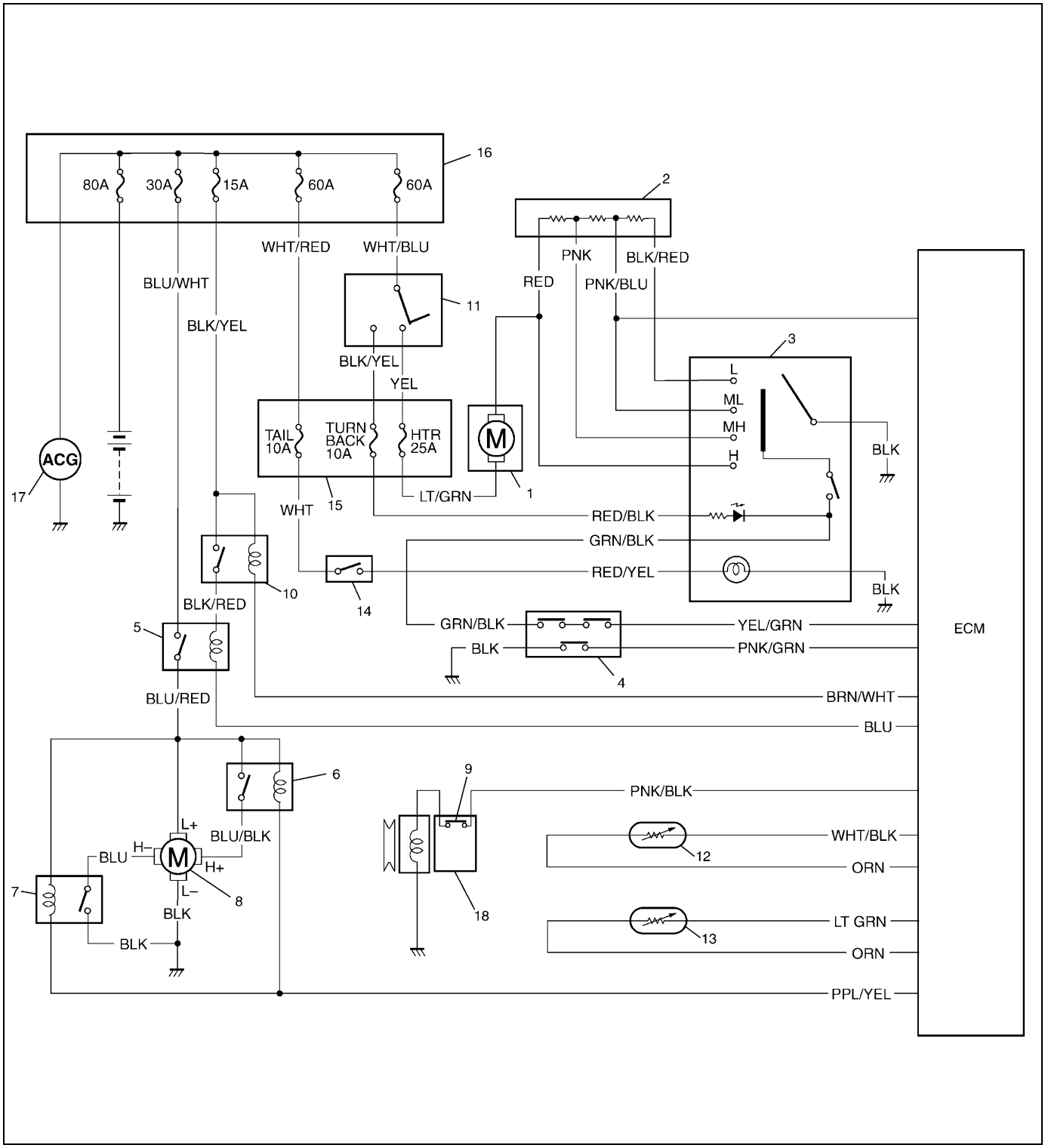
Electrical Diagnosis

Wiring Diagram

Except Sport Model



1. Blower fan motor	6. Radiator/condenser cooling fan relay No.2	11. Ignition switch	16. Main fuse box
2. Blower fan motor resistor	7. Radiator/condenser cooling fan relay No.3	12. A/C evaporator temperature sensor	17. Generator
3. Blower fan switch and A/C switch	8. Radiator/condenser cooling fan motor	13. ECT sensor	18. Compressor
4. A/C refrigerant pressure switch	9. Compressor thermal switch	14. Lighting switch	
5. Radiator/condenser cooling fan relay No.1	10. Main relay	15. Circuit fuse box	

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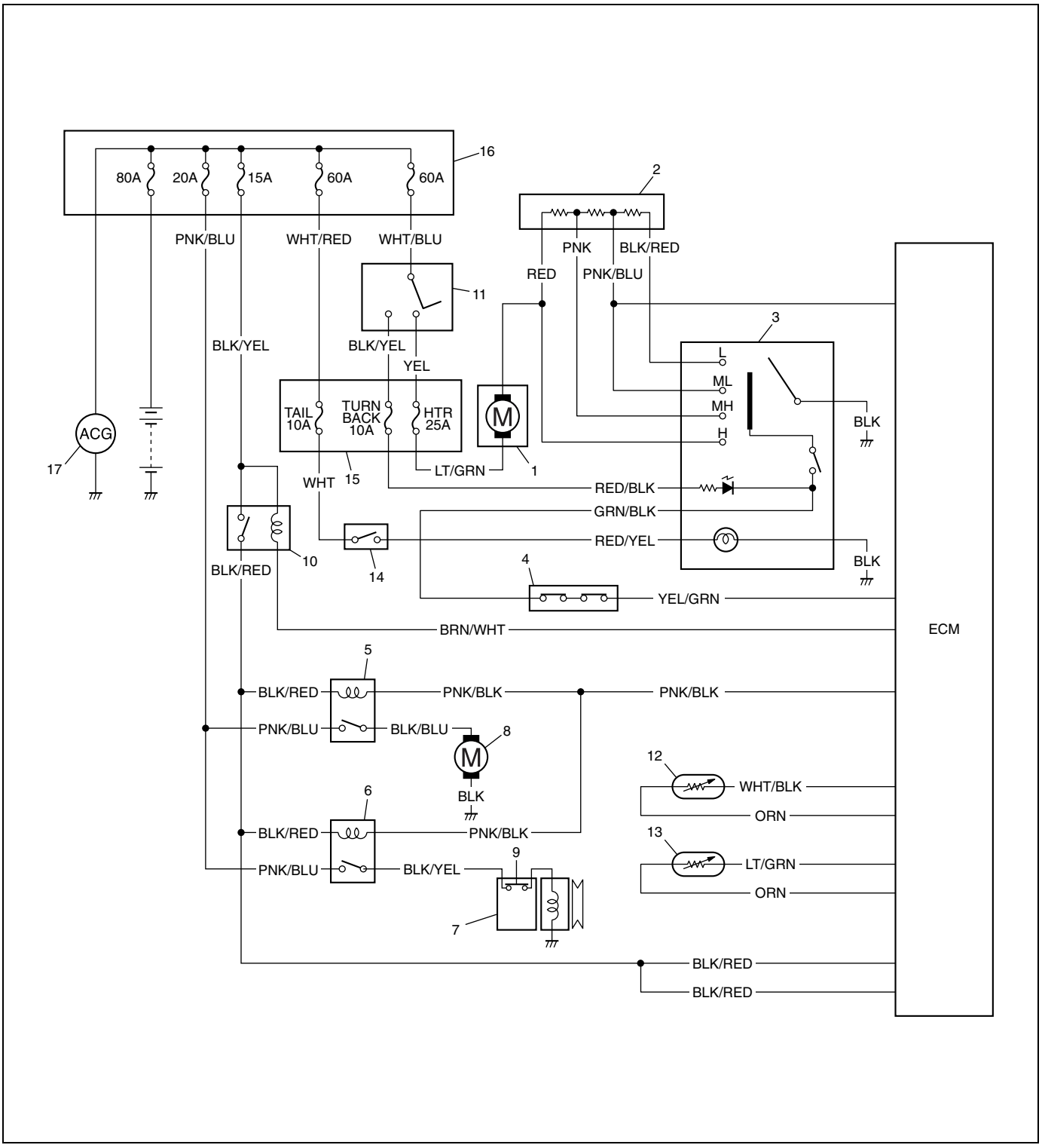
Sport Model



1. Blower fan motor	6. Compressor relay	11. Ignition switch	16. Main fuse box
2. Blower fan motor resistor	7. Compressor	12. A/C evaporator temperature sensor	17. Generator
3. Blower fan switch and A/C switch	8. Condenser cooling fan motor	13. ECT sensor	
4. A/C refrigerant pressure switch	9. Compressor thermal switch	14. Lighting switch	
5. Condenser cooling fan motor relay	10. Main relay	15. Circuit fuse box	

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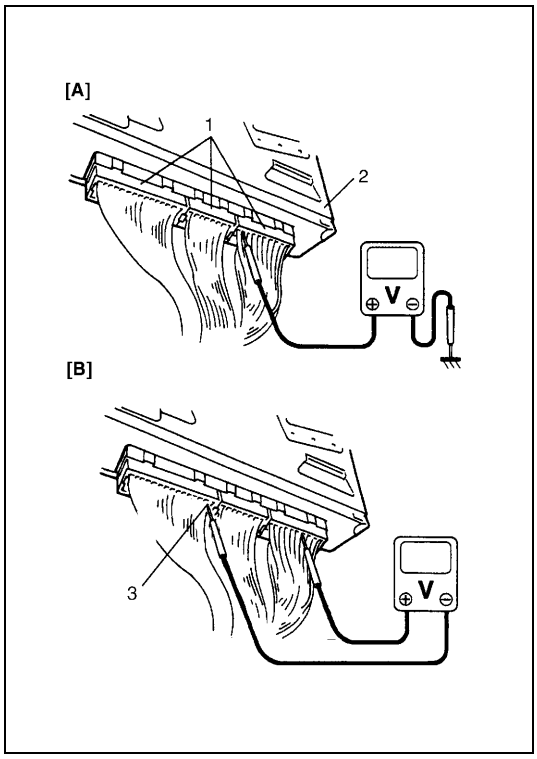
A/C System Inspection of ECM and Its Circuits

ECM and its circuits can be checked at ECM wiring couplers by measuring voltage.

CAUTION:

ECM cannot be checked by itself. It is strictly prohibited to connect voltmeter or ohmmeter to ECM with couplers disconnected from it.



Voltage Check

1) Remove ECM from vehicle by referring to “Engine control module (ECM)” in Section 6E1 or “Engine control module (ECM) removal and installation” in Section 6E2.
2) Connect ECM couplers (1) to ECM (2).
3) Check voltage at each terminal of couplers connected.

NOTE:

As each terminal voltage is affected by the battery voltage, confirm that it is 11 V or more when ignition switch is ON position.

[A] : Fig. A
[B] : Fig. B
3. C42-10

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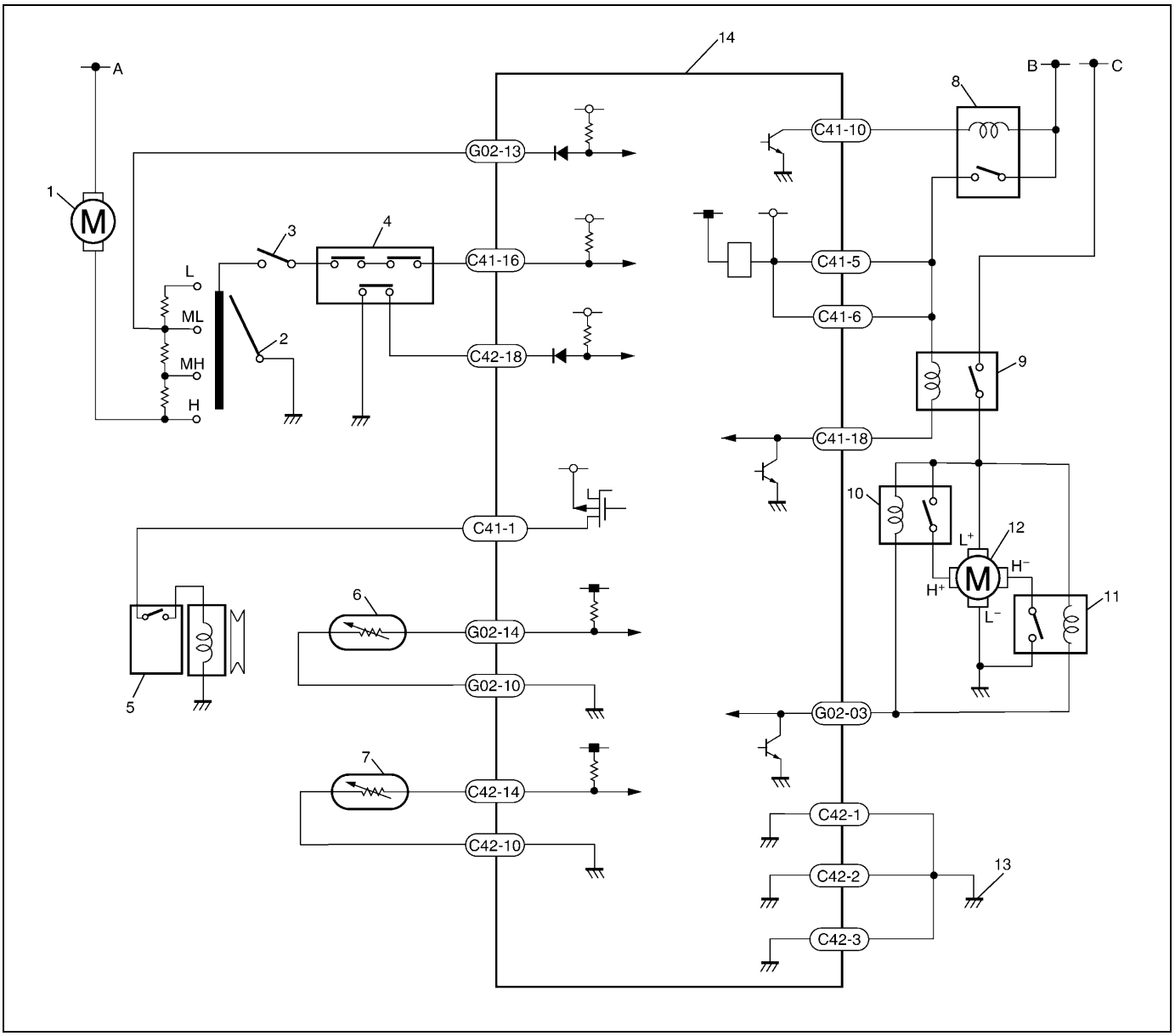
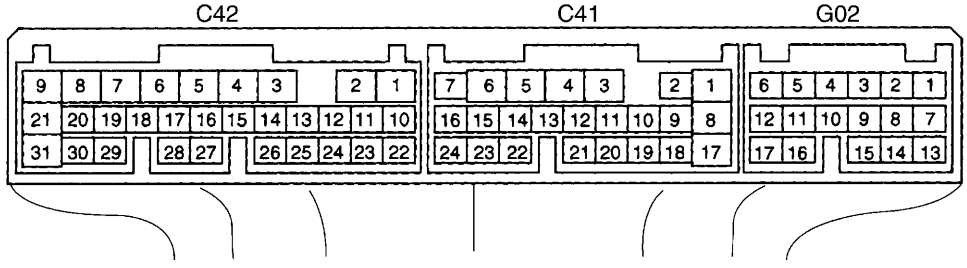
System Circuit (Except Sport Model)



1. Blower fan motor	8. Main relay	A. To “HTR” fuse (25 A) in circuit fuse box
2. Blower fan switch	9. Radiator/condenser cooling fan motor relay No.1	B. To main fuse (15 A)
3. A/C switch	10. Radiator/condenser cooling fan motor relay No.2	C. To main fuse (30 A)
4. A/C refrigerant pressure switch	11. Radiator/condenser cooling fan motor relay No.3	
5. Compressor	12. Radiator/condenser cooling fan motor	
6. A/C evaporator temperature sensor	13. Engine earth	
7. ECT sensor	14. ECM	

Terminal arrangement of ECM coupler (Viewed from harness side)



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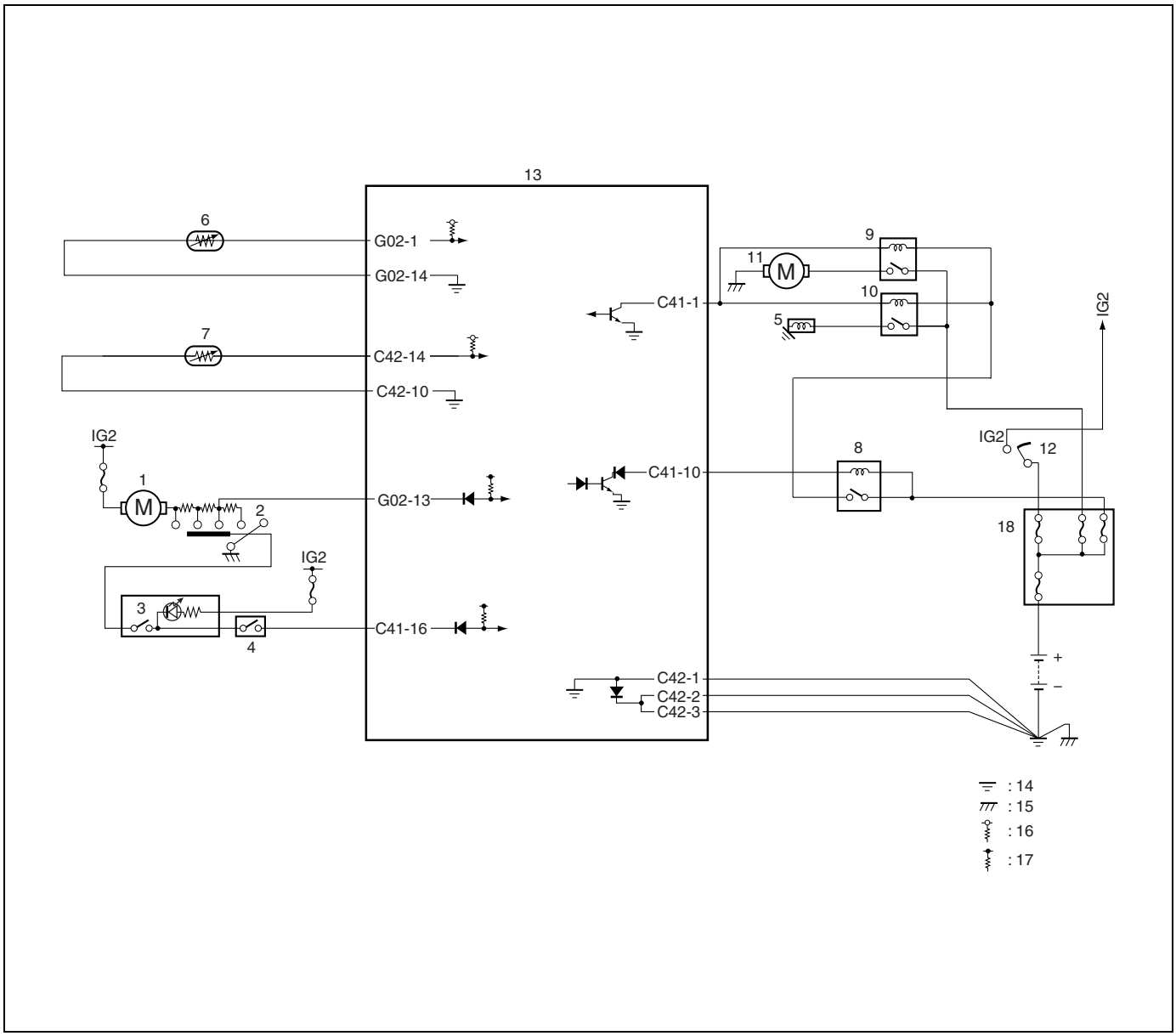
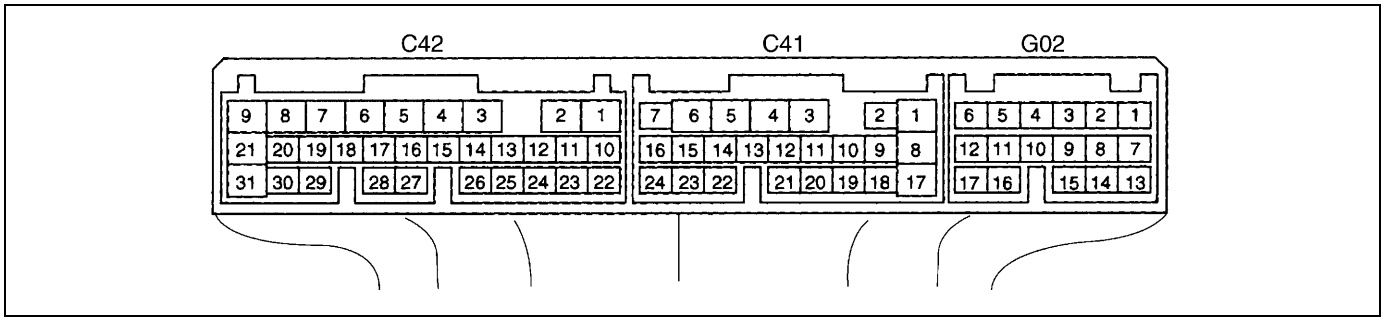
System Circuit (Sport Model)



1. Blower fan motor	8. Main relay	15. Body ground
2. Blower fan switch	9. Condenser cooling fan motor relay	16. 5 V
3. A/C switch	10. Compressor relay	17. 12V
4. A/C refrigerant pressure switch	11. Condenser cooling fan motor	
5. Compressor clutch	12. Ignition switch	
6. A/C evaporator temperature sensor	13. ECM	
7. ECT sensor	14. Engine ground	

Terminal arrangement of ECM coupler (Viewed from harness side)



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ECM Voltage Values Table for Relation of A/C Control (Except Sport Model)

Terminal	Wire	Circuit	Measurement ground	Normal value	Condition
C41-1	PNK/BLK	Compressor magnet clutch output	Ground to engine (Fig B)	12 – 15 V	Except the above-mentioned condition with engine running
				0 – 1 V	Blower fan switch and A/C switch ON with engine running
C41-5	BLK/RED	Main power supply for ECM	Ground to engine (Fig B)	10 – 14 V	Ignition switch ON with engine stopped
C41-6	BLK/RED	Main power supply for ECM	Ground to engine (Fig B)	10 – 14 V	Ignition switch ON with engine stopped
C41-10	BRN/ WHT	Main relay drive	Ground to engine (Fig B)	0.5 – 1.2 V	Ignition switch ON with engine stopped
				10 – 14 V	Ignition switch OFF
C41-16	YEL/GRN	A/C switch input	Ground to engine (Fig B)	12 – 15 V	Blower fan switch or A/C switch OFF with engine running
				0 – 1 V	Blower fan switch and A/C switch ON with engine running
C41-18	BLU	Radiator/condenser cooling fan relay output 1	Ground to engine (Fig B)	0 – 1 V	Blower fan switch and A/C switch ON
					Engine coolant temperature at more than 97.5 °C (207.5 °F) with engine running
				12 – 15 V	Blower fan motor switch or A/C switch OFF
					Engine coolant temperature at less than 97.5 °C (207.5 °F) with engine running
C42-1	BLK/ORN	Main ground for ECM	Ground to body (Fig A)	–0.5 – 1 V	Engine running
C42-2	BLK	ECM ground for power circuit	Ground to body (Fig A)	–0.5 – 1 V	Engine running
C42-3	BLK/ORN	ECM ground for power circuit	Ground to body (Fig A)	–0.5 – 1 V	Engine running
C42-10	ORN	Sensor ground for ECT sensor	Ground to body (Fig A)	–0.5 – 1 V	Engine running
C42-14	LT GRN	ECT sensor input	Ground to engine (Fig B)	0.71 – 0.75 V (298 – 320 Ω)	Engine coolant temperature at approximately 80 °C (176 °F) with engine running
				0.35 – 0.37 V (135 – 144 Ω)	Engine coolant temperature at Approximately 110 °C (230 °F) with engine running If the temperature is more than 114 °C (237.2 °F), compressor and condenser cooling fan should be stop (come back at less than 112 °C (233.6 °F))
C42-18	PNK/GRN	Medium pressure switch input	Ground to engine (Fig B)	–0.5 – 1 V	Medium pressure switch of A/C refrigerant pressure switch ON
				12 – 15 V	Medium pressure switch of A/C refrigerant pressure switch OFF
G02-3	PPL/YEL	Radiator/Condenser cooling fan relay output 2	Ground to engine (Fig B)	0 – 1 V	Blower fan motor switch ON, A/C switch ON and medium pressure switch OFF
					Engine coolant temperature at more than 102.5 °C (216.5 °F) with engine running
				12 – 15 V	Blower fan motor switch OFF, A/C switch OFF or medium pressure switch ON
					Engine coolant temperature at less than 102.5 °C (216.5 °F) with engine running
G02-10	ORN	Sensor ground for A/C evaporator temperature sensor	Ground to engine (Fig A)	–0.5 – 1 V	Engine running
G02-13	PNK/BLU	Blower fan speed input	Ground to engine (Fig B)	0 – 1 V	Blower fan motor switch “ML”, “MH”, or “H” with engine running
				4 – 7 V	Blower fan motor switch “L” position with engine running
				12 – 15 V	Blower fan motor switch OFF with engine running
G02-14	WHT/BLK	A/C evaporator temperature sensor input	Ground to engine (Fig B)	2.09 – 2.17 V (1940 – 2060 Ω)	A/C evaporator temperature at approximately 25 °C (77 °F) with engine running
				3.52 – 3.59 V (6450 – 6850 Ω)	A/C evaporator temperature at approximately 0 °C (32 °F) with engine running If the temperature is less than approximately 2.5 °C (36.5 °F), compressor and condenser cooling fan should be stop (come back at more than approximately 4 °C (39.2 °F)

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ECM Voltage Values Table for Relation of A/C Control (Sport Model)

Terminal	Wire	Circuit	Measurement ground	Normal value	Condition
C41-1	PNK/BLK	A/C compressor clutch and condenser fan switch	Ground to engine (Fig B)	0 – 1 V	Fulfill all the following conditions: • Blower speed selector ON • A/C switch ON • Engine running • A/C pressure sensor ON
				12 – 15 V	Except the above mentioned condition with engine running
C41-5	BLK/RED	Main power supply for ECM	Ground to engine (Fig B)	10 – 14 V	Ignition switch ON with engine not running
C41-6	BLK/RED	Main power supply for ECM	Ground to engine (Fig B)	10 – 14 V	Ignition switch ON with engine not running
C41-10	BRN/WHT	Main relay drive	Ground to engine (Fig B)	0.5 – 1.2 V	Ignition switch ON with engine not running
				10 – 14 V	Ignition switch OFF
C41-16	YEL/GRN	A/C switch input	Ground to engine (Fig B)	10 – 14 V	Except the above mentioned condition with engine running
				0 – 1 V	Fulfill all the following conditions: • Blower speed selector ON • A/C switch ON • Engine running • A/C pressure sensor ON
C42-1	BLK/ORN	Main ground for ECM	Ground to body (Fig A)	–0.5 – 1 V	Engine running
C42-2	BLK	ECM ground for power circuit	Ground to body (Fig A)	–0.5 – 1 V	Engine running
C42-3	BLK/ORN	ECM ground for power circuit	Ground to body (Fig A)	–0.5 – 1 V	Engine running
C42-10	ORN	Sensor ground for ECT sensor	Ground to body (Fig A)	–0.5 – 1 V	Engine running
C42-14	LT GRN	ECT sensor input	Ground to engine (Fig B)	0.71 – 0.75 V (298 – 320 Ω)	Engine coolant temperature at approximately 80 °C (176 °F) with engine running
				0.35 – 0.37 V (135 – 144 Ω)	Engine coolant temperature at Approximately 110 °C (230 °F) with engine running. If the temperature is more than 112.5 °C (234.5 °F), compressor and condenser cooling fan should stop (restart at less than 110 °C (230 °F)
G02-1	WHT/BLK	A/C evaporator temperature sensor input	Ground to engine (Fig B)	2.09 – 2.17 V (1940 – 2060 Ω)	Evaporator thermistor temperature at approximately 25 °C (77 °F) with engine running
				3.52 – 3.59 V (6450 – 6859 Ω)	A/C evaporator thermistor at approximately 0 °C (32 °F) with engine running. If the temperature is less than approximately 2.5 °C (36.5 °F), compressor and condenser cooling fan should stop (restart at more than approximately 4 °C (39.2 °F)
G02-14	ORN	Sensor ground for A/C evaporator temperature sensor	Ground to body (Fig A)	–0.5 – 1 V	Engine running
G02-13	PNK/BLU	Blower fan speed input	Ground to engine (Fig B)	0 – 1 V	Blower fan motor switch “ML”, “MH” or “H” with engine running
				4 – 7 V	Blower fan motor switch “L” position with engine running
				10 – 14 V	Blower fan motor switch OFF with engine running

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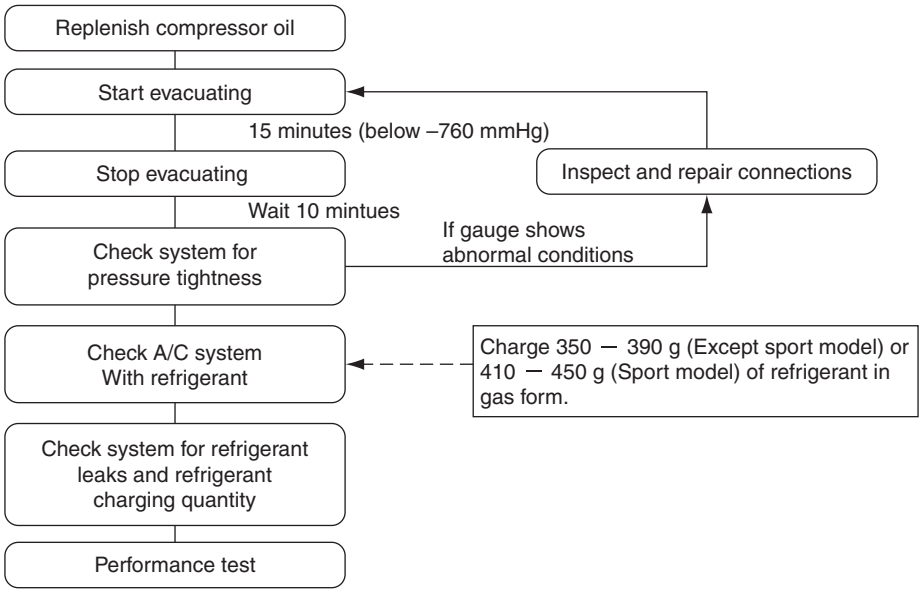
Refrigerant Recovery, Evacuating and Charging

Operation Procedure for Refrigerant Charging


Replenish compressor oil
Start evacuating
15 minutes (below –760 mmHg)
Stop evacuating
Inspect and repair connections
Wait 10 mintues
If gauge shows abnormal conditions
Check system for pressure tightness
Check A/C system With refrigerant
Charge 350 — 390 g (Except sport model) or 410 — 450 g (Sport model) of refrigerant in gas form.
Check system for refrigerant leaks and refrigerant charging quantity
Performance test

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On-Vehicle Service

WARNING:

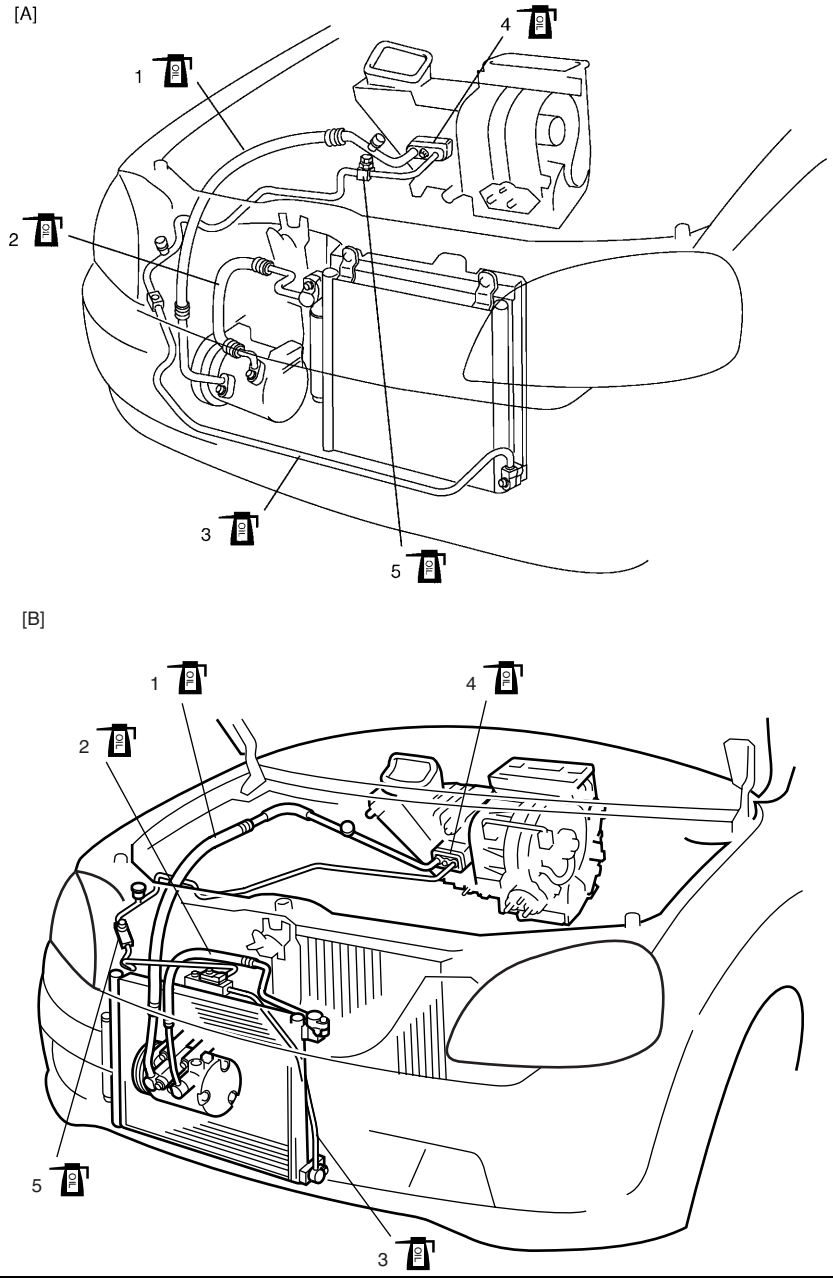
Should refrigerant HFC-134a (R-134a) strike your eye(s), consult a doctor immediately.

- **Do not use your hand to rub affected eye(s). Instead, use quantities of fresh cold water to splash it over affected area to thus gradually raise its temperature above the freezing point.**
- **Obtain proper treatment as soon as possible from a doctor or eye specialist. Should liquid refrigerant HFC-134a (R-134a) get on your skin, such affected part should be treated in the same manner as when skin is frostbitten or frozen.**

Service Precaution

When servicing air conditioning system, note the following instructions.

Refrigerant line



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[A]: Except sport model	1. Suction hose: Apply compressor oil (refrigerant oil) to O-ring.	4. Expansion valve: Apply compressor oil (refrigerant oil) to O-ring.
[B]: Sport model	2. Discharge hose: Apply compressor oil (refrigerant oil) to O-ring.	5. A/C refrigerant pressure switch: Apply compressor oil (refrigerant oil) to O-ring.
	3. Condenser outlet pipe: Apply compressor oil (refrigerant oil) to O-ring.	

- Never use heat for bending pipes. When bending a pipe, try to make its bending radius as slight as possible.
- Keep internal parts of air conditioning free from moisture and dirt. When disconnecting any line from system, install a blind plug or cap to the fitting immediately.
- When connecting hoses and pipes, apply a few drops of compressor oil (refrigerant oil) to seats of coupling nuts and O-ring.
- When tightening or loosening a fitting, use two wrenches, one for turning and the other for support.
- Tighten flared nuts by the following specified torque.

Tightening torque
8 mm pipe: 13 N·m (1.3 kg-m, 9.5 lb-ft)
12 mm pipe: 23 N·m (2.3 kg-m, 17.0 lb-ft)
14.5 mm pipe: 33 N·m (3.3 kg-m, 24.0 lb-ft)

Condenser Assembly (Sport Model)

CAUTION:
Be careful not to damage condenser fins. If condenser fin is bent, straighten it by using flat head screwdriver or pair of pliers.

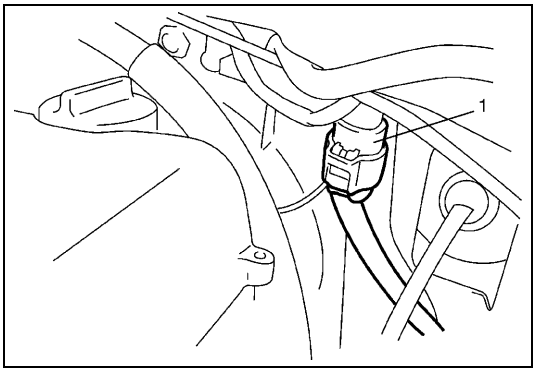
NOTE:
For except sport model, refer to the same section of the Service Manual mentioned in "FOREWORD" of this manual.

Removal

1) Disconnect negative (–) cable at battery.
2) Recover refrigerant from A/C system by referring to "Recovery" in this section.

NOTE:
The amount of removed compressor oil must be measured for replenishing compressor oil.

3) Remove front bumper referring to "Front Bumper and Rear Bumper" in Section 9.
4) Disconnect condenser cooling fan motor coupler (1).



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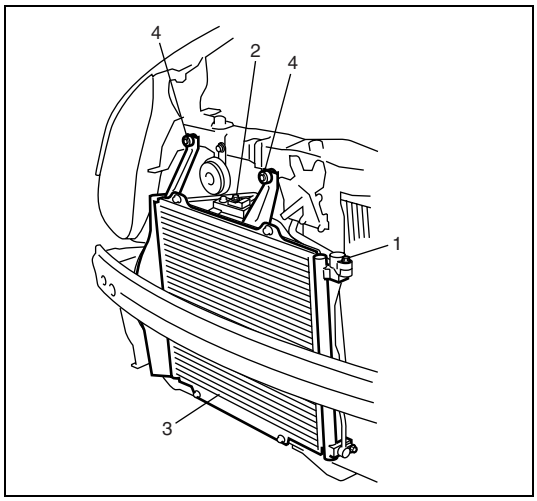


5) Disconnect discharge hose (1) and liquid pipe (2) from condenser assembly (3).
6) Remove condenser assembly mounting bolts (4).
7) Remove condenser assembly (3).

Installation

Reverse removal procedure to install condenser noting the following instructions.

- Replenish specified amount of compressor oil to compressor suction side by referring to “Replenishing Compressor Oil” in this section.
- Evacuate and charge refrigerant by referring to “Evacuating” and “Charging” in this section.

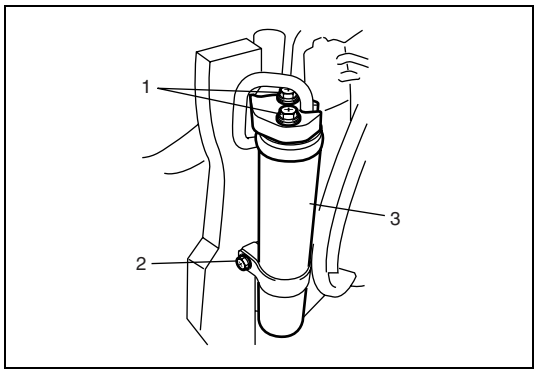
Receiver/Dryer (Sport Model)

NOTE:

For except sport model, refer to the same section of the Service Manual mentioned in “FOREWORD” of this manual.

Removal

1) Remove condenser assembly referring to “Condenser Assembly (Sport Model)” in this section.



2) Loosen receiver / dryer attachment bolts (1), (2).
3) Remove receiver / dryer (3).

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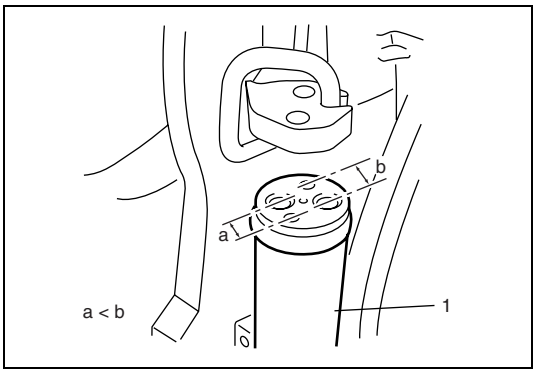
Installation

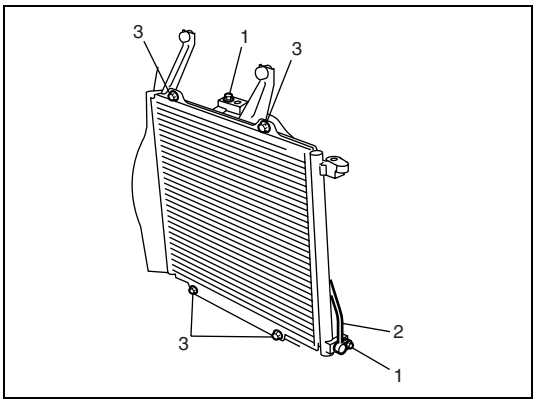
Reverse removal procedure to install receiver / dryer noting the following instructions.



- Replenish specified amount of compressor oil to compressor suction side referring to “Replenishing Compressor Oil” in this section.
- Be sure to install receiver / dryer (1) to proper direction as shown.
- Evacuate and charge refrigerant referring to “Evacuating” and “Charging” in this section.

Condenser Cooling Fan Assembly (Sport Model)

Removal



1) Remove condenser assembly referring to “Condenser Assembly (Sport Model)” in this section.
2) Remove condenser outlet pipe mounting bolts (1) and condenser outlet pipe (2).
3) Remove condenser cooling fan assembly mounting bolts (3).
4) Remove condenser cooling fan assembly from condenser.

Installation

Reverse removal procedure to install condenser cooling fan motor nothing the following instructions.

- Replenish specified amount of compressor oil to compressor suction side by referring to “Replenishing Compressor Oil” in this section.
- Evacuate and charge refrigerant by referring to “Evacuating” and “Charging” in this section.

Condenser Cooling Fan Motor (Sport Model)

Removal and Installation

For details, refer to “Condenser Cooling Fan Assembly (Sport Model)” in this section.

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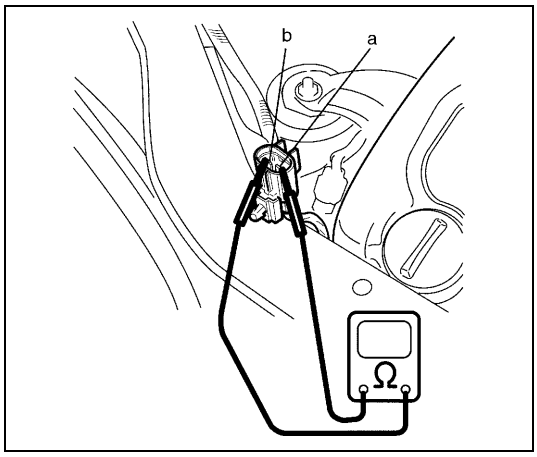
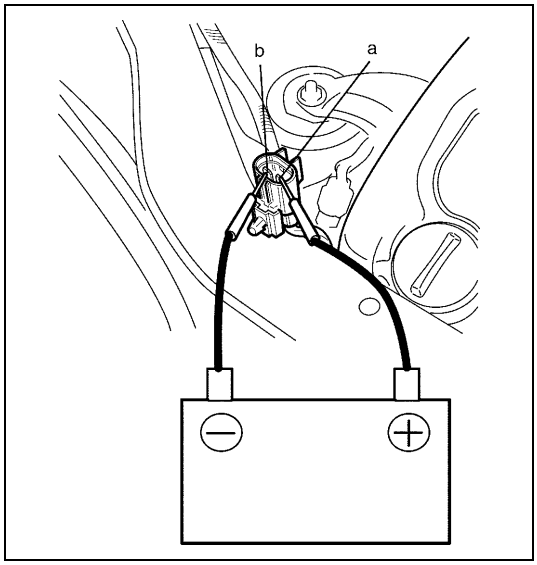
Inspection



1) Check condenser cooling fan motor for continuity between terminal “a” and “b” as shown.
   If there is no continuity, replace condenser cooling fan motor.



2) Connect battery to condenser cooling fan motor terminal “a” and “b” as shown in figure, then check that the condenser cooling fan motor operates smoothly.

   Reference:
   Condenser cooling fan specified current at 12 V:
   8 A maximum

3) Check condenser cooling fan blade for damage. If any malfunction is found replace condenser cooling fan.

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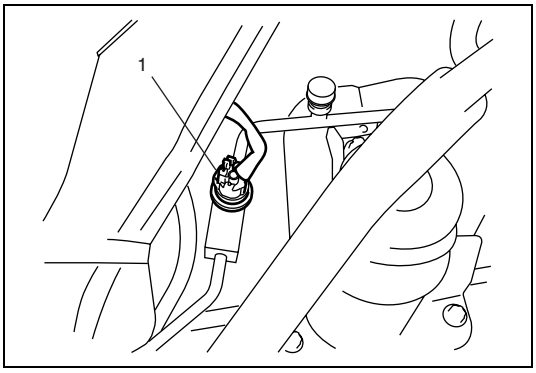
A/C Refrigerant Pressure Switch (Sport Model)

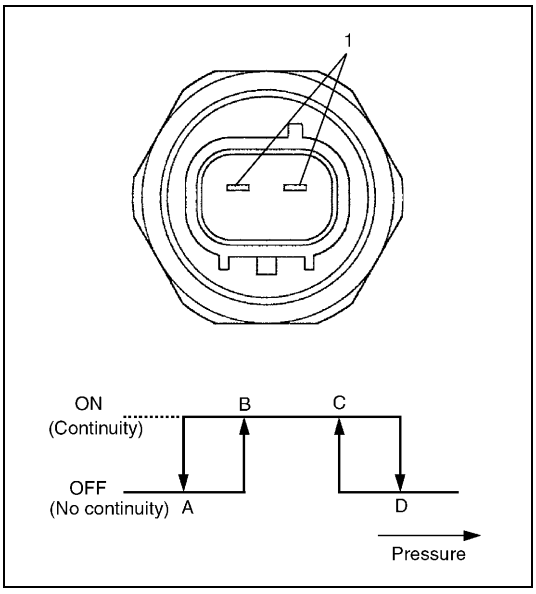
NOTE:

For except sport model, refer to the same section of the Service Manual mentioned in "FOREWORD" of this manual.

Inspection



1) Check A/C refrigerant pressure switch (1) for continuity at normal temperature (approximately 25 °C (77 °F)) when A/C system has a proper charge of refrigerant and A/C system (compressor) is under operation. In each of these cases, switch should show proper continuity.



2) Check continuity between high and low pressure switch terminals (1) at specified pressure as shown.

High and low pressure switch specification

A : Approximately 200 kPa (2.0 kg/cm^2, 28.5 psi)

B : Approximately 230 kPa (2.3 kg/cm^2, 32.5 psi)

C : Approximately 2600 kPa (26 kg/cm^2, 370 psi)

D : Approximately 3200 kPa (32 kg/cm^2, 455 psi)

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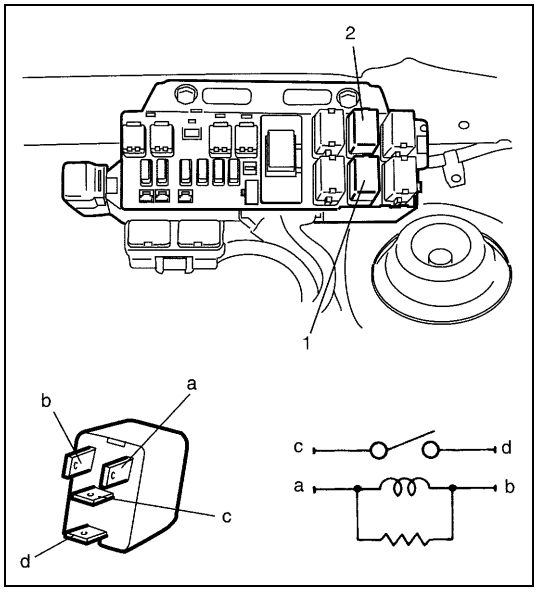
A/C Compressor Relay and A/C Condenser Cooling Fan Relay (Sport Model)

Inspection



1) Disconnect negative (–) cable at battery.
2) Remove condenser cooling fan motor relay (2) and/or compressor relay (1) from vehicle.
3) Check that there is no continuity between terminal “c” and “d”. If there is continuity, replace relay.
4) Connect battery positive (+) terminal to terminal “b” of relay.
   Connect battery negative (–) terminal “a” of relay.
   Check continuity between terminal “c” and “d”.
   If there is no continuity when relay is connected to the battery, replace relay.

Compressor (Sport Model)

NOTE:

For except sport model, refer to the same section of the Service Manual mentioned in “FOREWORD” of this manual.

Removal

1) Run engine at idle speed with air conditioning ON for 10 minutes. After that stop the engine.
2) Disconnect negative (–) cable at battery.
3) Recover refrigerant from refrigeration system by referring to “Recovery” in this section.

NOTE:

The amount of removed compressor oil must be measured for replenishing compressor oil.

4) Remove front bumper by referring to “Front Bumper and Rear Bumper” in Section 9.

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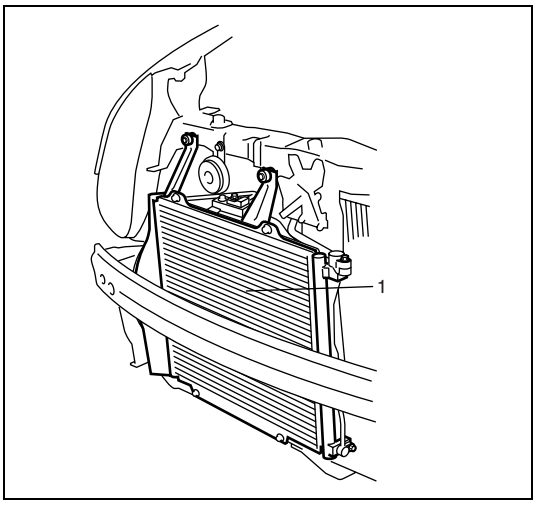
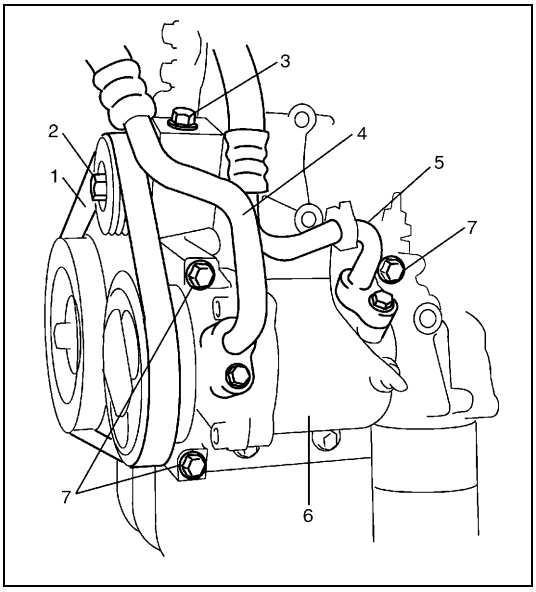


5) Remove condenser (1) from vehicle body referring to “Condenser Assembly (Sport Model)” in this section.



6) Remove compressor drive belt (1) by loosening tension pulley nut (2) and adjusting bolt (3).
7) Disconnect magnet clutch lead wire coupler.
8) Disconnect suction pipe (4) and discharge hose (5) from compressor (6).

NOTE:

Cap open fittings immediately to keep moisture out of system.

9) Remove compressor mounting bolts (7), and then remove compressor (6) from its bracket.

Installation

Reverse removal procedure to install compressor noting the following instructions.

- If compressor is replaced, pour new compressor oil by referring to “Replenishing Compressor Oil” in this section.
- Evacuate and charge system by referring to “Recovery” in this section.
- Adjust drive belt tension by referring to “Compressor Drive Belt” in this section.

Tightening Torque Specifications

Fastening part		Tightening torque		
		N•m	kg-m	lb-ft
Refrigerant line	8 mm pipe	13	1.3	9.5
	12 mm pipe	23	2.3	17.0
	14.5 mm pipe	33	3.3	24.0
Magnet clutch plate		16	1.6	11.5
Relief valve		10	1.0	7.5

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SECTION 3A

FRONT END ALIGNMENT

NOTE:

For the items with asterisk (*) in the "CONTENTS" below, refer to the same section of the Service Manual mentioned in "FOREWORD" of this manual.

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Toe Setting 3A-2
Camber 3A-3
Alignment Service Data (Reference) ..... *
Caster (Reference) 3A-3
Diagnosis 3A-3
Diagnosis Table ..... *
Preliminary Checks Prior to Adjusting Front Alignment ..... *
Toe Adjustment ..... *
Camber and Caster Check and Adjustment ..... *
Steering Angle Check and Adjustment 3A-3
Side Slip (Reference) 3A-4

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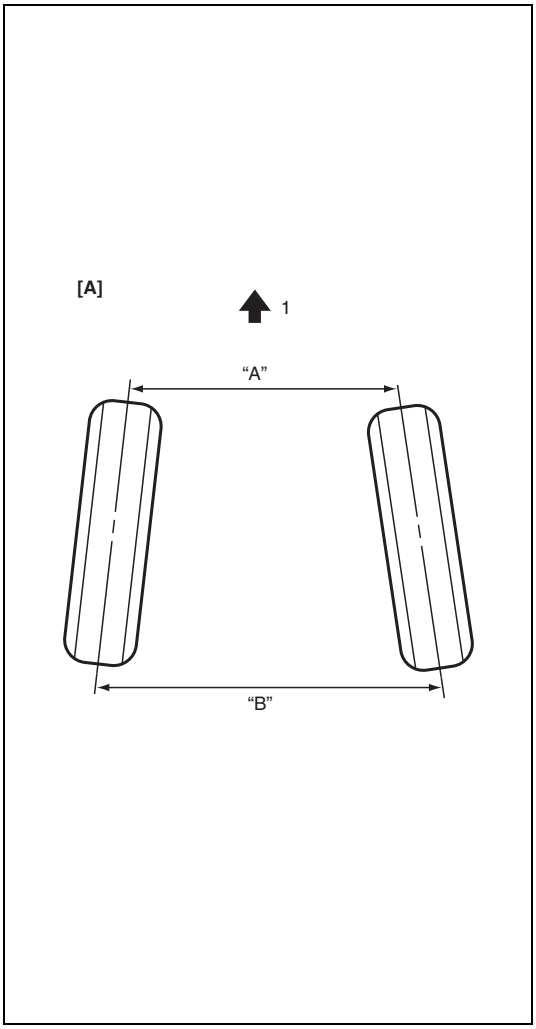
General Description



Front alignment refers to the angular relationship between the front wheels, the front suspension attaching parts and the ground. Generally, the only adjustment required for front alignment is toe setting.

Camber and caster can't be adjusted. Therefore, should camber or caster be out of specification due to the damage caused by hazardous road conditions or collision, whether the damage is in body or in suspension should be determined. If the body is damaged, it should be repaired and if suspension is damaged, it should be replaced.

Toe Setting

Toe is the turning in or out of the front wheels. The purpose of a toe specification is to ensure parallel rolling of the front wheels (Excessive toe-in or toe-out may increase tire wear).

Toe-in

"B" – "A": 0 ± 1 mm (0 ± 0.039 in.) ··· Except sport model

2 ± 1 mm (0.787 ± 0.039 in.) ··· Sport model

NOTE:

Toe-in value was measured by using a toe-in gauge.

For adjusting toe setting, refer to "Toe Adjustment" in this section.

[A]: Wheel top view
1. Forward

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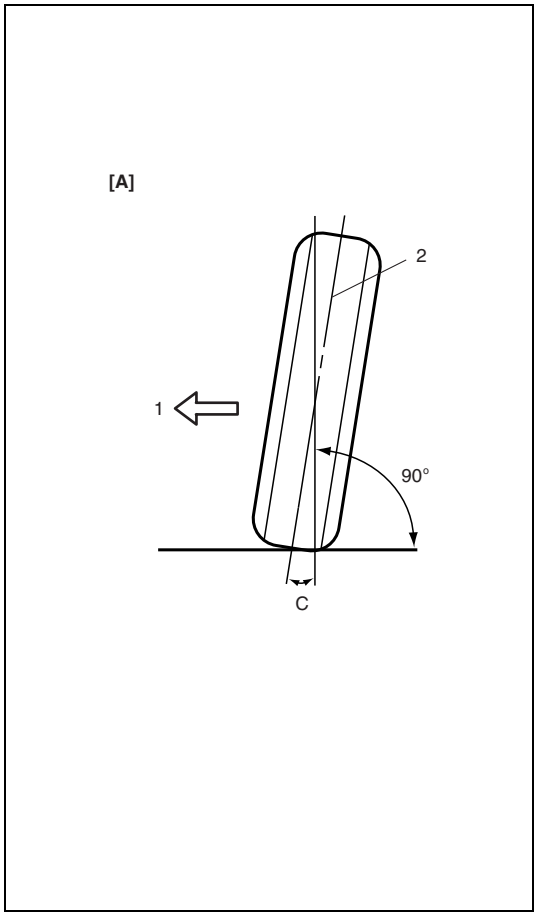
Camber



Camber is the tilting of the front wheels from the vertical, as viewed from the front of the vehicle. When the wheels tilt outward at the top, the camber is positive. When the wheels tilt inward at the top, the camber is negative. The amount of tilt is measured in degrees.

Camber "C"
2WD vehicle: –0° 20' ± 1° ··· Except sport model
0° ± 1° ····· Sport model
4WD vehicle: 0° ± 1°

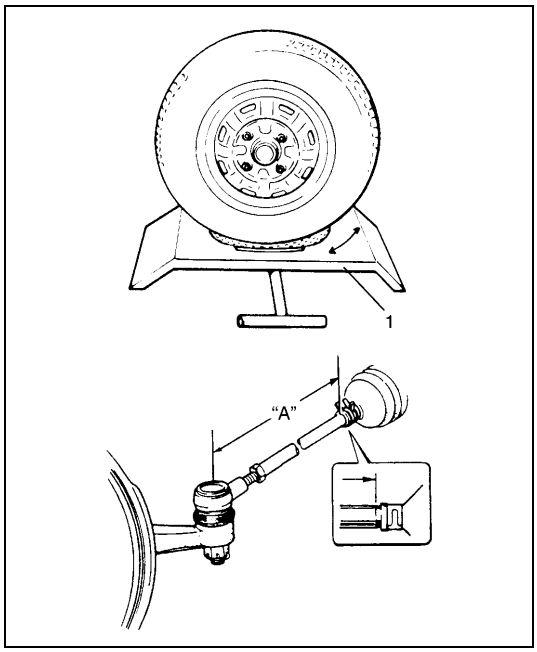
Caster (Reference)

2WD vehicle: 3° 25' ± 2° ····· Except sport model
3° 44' ± 2° ····· Sport model
4WD vehicle: 3° 35' ± 2°

1. Body center	[A]: Front view
2. Center line of wheel	

Diagnosis

Steering Angle Check and Adjustment



When tie rod or tie rod end was replaced, check toe and then also steering angle with turning radius gauge (1).
If steering angle is not correct, check if right and left tie rods are equal in length "A".

NOTE:
If tie rod lengths were changed to adjust steering angle, reinspect toe-in.

Steering angle
Inside: 35° ± 2° ····· Except sport model
33° ± 2° ····· Sport model
Outside: 31° (Reference) ····· Except sport model
30° (Reference) ····· Sport model

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Side Slip (Reference)

For inspecting front wheel side slip with side slip tester:

Side slip specification
0 – IN 3 mm/m (0 – IN 0.118 in/3.3 ft)

If side slip exceeds above specification, toe-in or front wheel alignment may not be correct.

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SECTION 3B

MANUAL RACK AND PINION

WARNING:

For vehicles equipped with a Air Bag System

- **Service on or around air bag system components or wiring must be performed only by an authorized SUZUKI dealer. Please observe all WARNINGS and CAUTIONS in SECTION 10B and Precautions, Air Bag System Components and Wiring Location view in Section 10B before performing service on or around air bag system components or wiring. Failure to follow WARNINGS could result in unintended activation of the system or could render the system inoperative. Either of these two conditions may result in severe injury.**
- **Technical service work must be started at least 90 seconds after the ignition switch is turned to the "LOCK" position and the negative cable is disconnected from the battery. Otherwise, the system may be deployed by reserve energy in the Sensing and Diagnostic Module (SDM).**

NOTE:

- **All steering gear fasteners are important attaching parts in that they could affect the performance of vital parts and systems, and/or could result in major repair expense. They must be replaced with one of the same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of these parts.**
- **For the items with asterisk (*) in the "CONTENTS" below, refer to the same section of the service Manual mentioned in "FOREWORD" of this manual.**

CONTENTS

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Tie Rod End ..... *
Manual Rack and Pinion Assembly (Steering Gear Case) 3B-3
Rack Boot/Tie Rod 3B-6
Steering Rack Plunger 3B-7
Steering Pinion 3B-8
Steering Rack 3B-9
Pinion Bearing 3B-10
Rack Bushing ..... *
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Required Service Material **3B-11**
Special Tool **3B-11**

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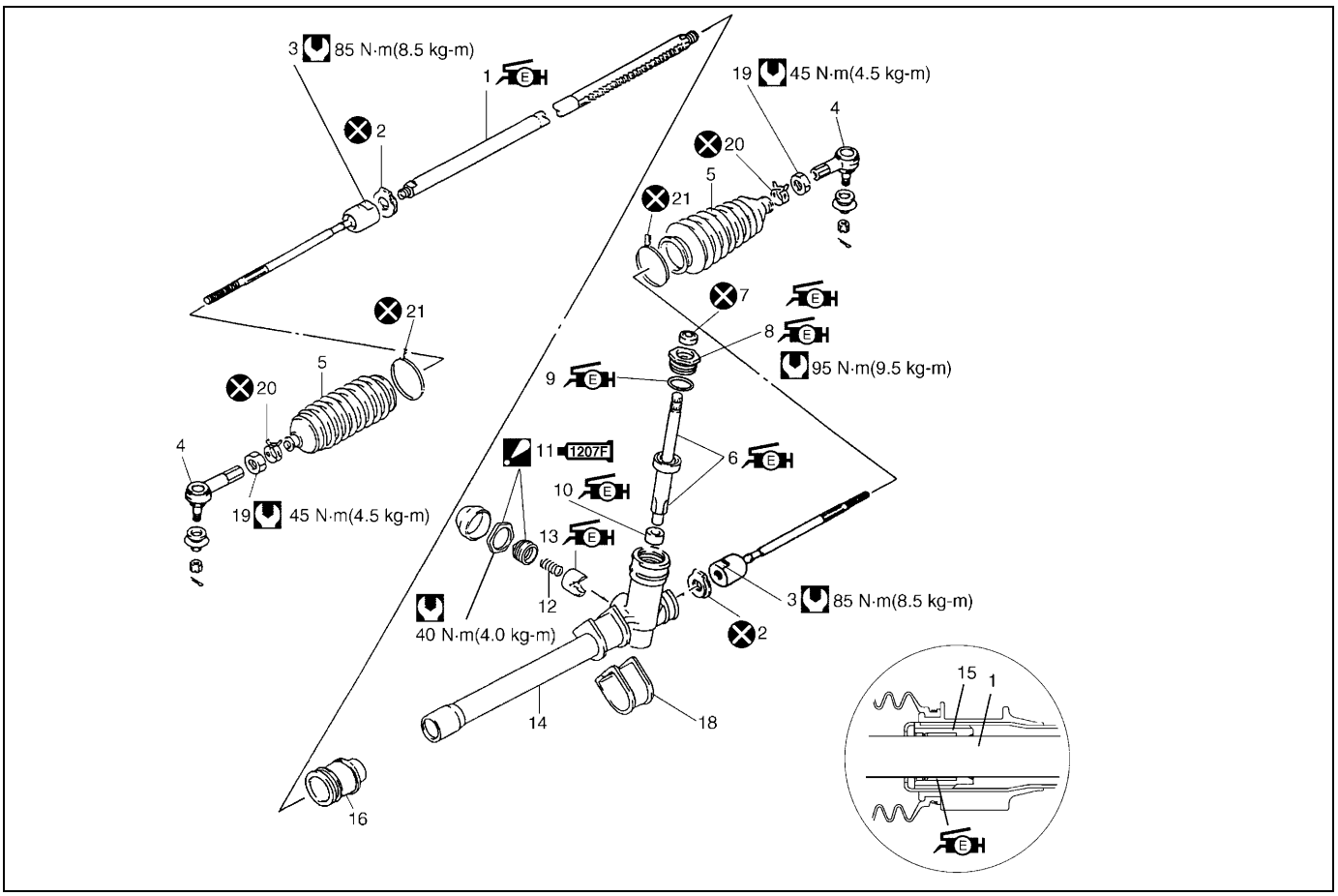
On-vehicle Service

Lubrication

When inner parts of the steering gear case were disassembled, they should be washed clean before reassembly. It is recommended to use the grease as given below where grease application is indicated in the text.

∗ SUZUKI SUPER GREASE (E) 99000-25050, or Lithium grease (applicable for –40°C ~ 130°C or 104°F ~ 266°F)



E	1. Steering rack : Apply grease 99000-25050 to teeth surface of rack.	E	13. Steering rack plunger : Apply grease 99000-25050 to sliding part of plunger.
	2. Tie rod lock washer		14. Steering rack housing and gear case
	3. Steering tie rod	E	15. Steering rack bushing : Apply grease 99000-25050 to lightly to entire surface of bushing.
	4. Tie rod end		16. Rack side mount
	5. Boot		17. Blank
E	6. Steering pinion : Apply grease 99000-25050 to pinion teeth.		18. Steering pinion side mount
E	7. Steering pinion shaft oil seal : Apply grease 99000-25050 to oil seal lip.		19. Tie rod end lock nut
E	8. Pinion bearing plug : Apply grease 99000-25050 to inside of pinion bearing plug.		20. Rack boot clip
E	9. O-ring : Apply grease 99000-25050 to O-ring		21. Wire
E	10. Steering pinion needle bearing : Apply grease 99000-25050 to rollers of bearing.		Tightening torque
1207F	11. Rack damper screw : Tighten rack damper screw so that rotation torque becomes as specified. : Apply sealant No. 1207F 99000-31250 to all around thread part of rack damper screw lock nut.		Do not reuse.
	12. Rack plunger spring		

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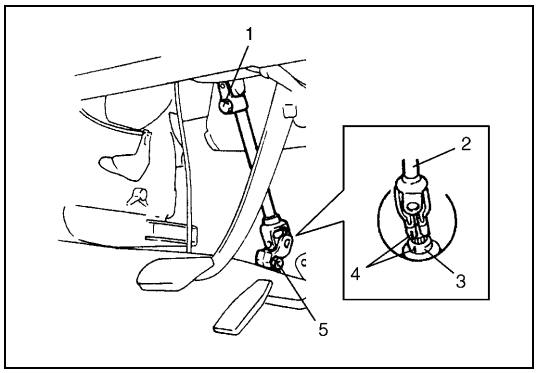
Manual Rack and Pinion Assembly (Steering Gear Case)

Removal

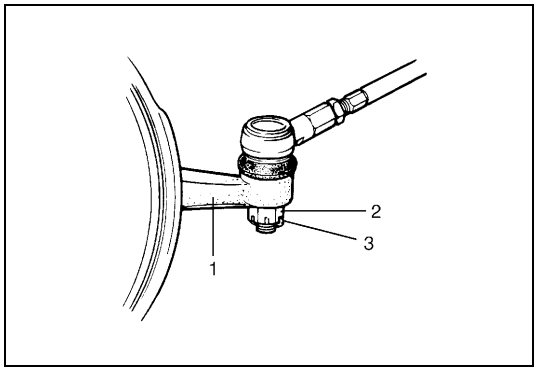
CAUTION:
Be sure to set front wheels in straight direction and remove ignition key from key cylinder before these steps, otherwise contact coil of air bag system may get damaged.

1) Slide driver's seat as far back as possible.
2) Pull off front part of floor mat on driver's side and remove steering shaft joint cover.

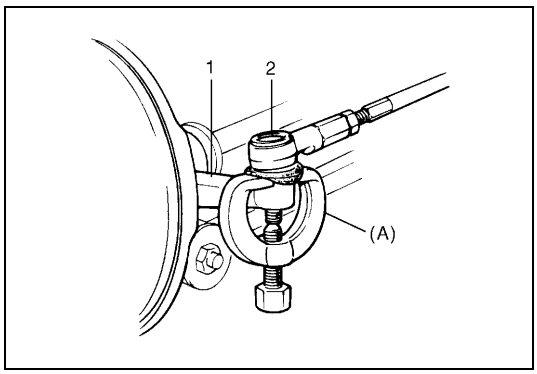


3) Make alignment marks (4) on lower steering shaft joint (2) and steering pinion shaft (3) as shown.
4) For ease of installation, loosen steering shaft upper joint bolt (1), but do not remove.
5) Remove steering shaft lower joint bolt (5) and disconnect lower joint from pinion.

6) Hoist vehicle and remove both wheels.



7) Remove split pins (3) and tie rod castle nuts (2) from both knuckles (1).



8) Disconnect both tie rod ends (2) from knuckles (1), using special tool.

Special tool
(A): 09913-65210

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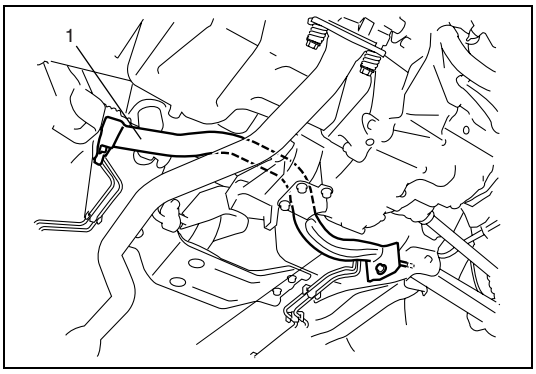
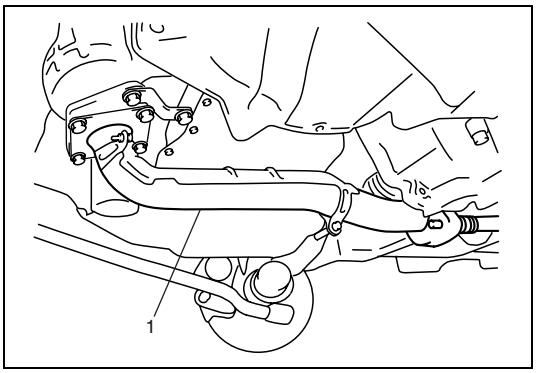
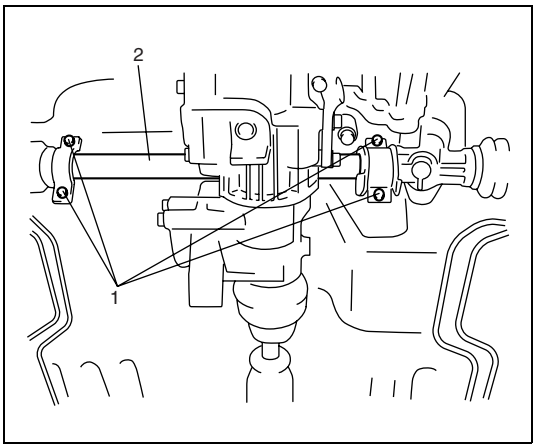


9) Remove crossmember (1) (Sport model)



10) Remove exhaust No.1 pipe (1).
11) For ease of adjustment after installation, make marking of tie rod end lock nut position on tie rod end thread. Then loosen lock nut and remove tie rod end.



12) Remove steering gear case mount bolts (1) and gear case brackets, then remove gear case (2).

NOTE:

For right-hand steering 4WD vehicle, before removing steering gear case, remove transfer assembly referring to Section 7D if necessary.

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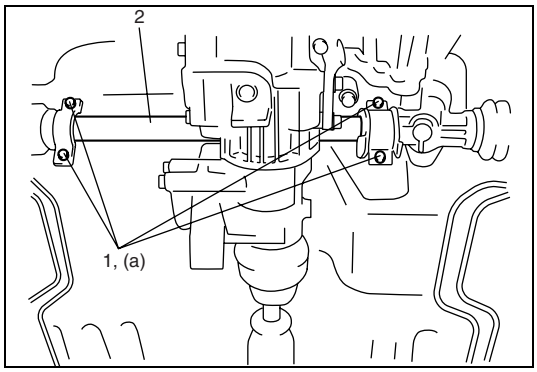
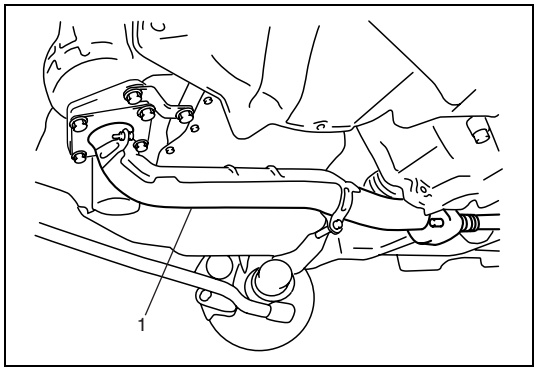
Installation

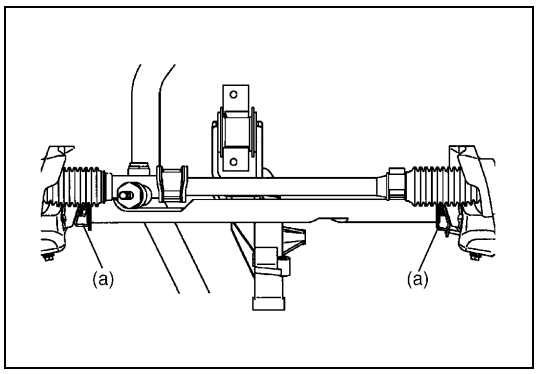


1) Mount steering gear case (2) to body and tighten gear case mount bolts (1) to specified torque.

Tightening torque
Gear case mount bolt (a): 25 N·m (2.5 kg-m, 18.0 lb-ft)

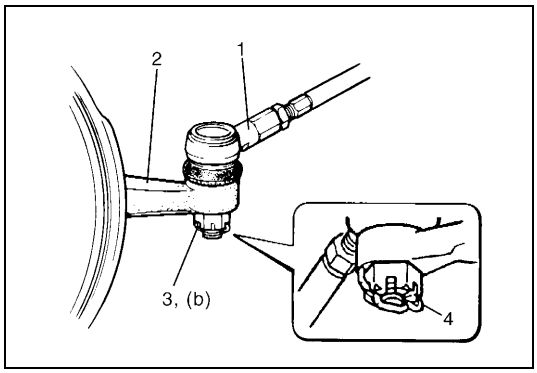


2) Install exhaust No.1 pipe (1).



3) Install crossmember (Sport model), referring to installation under “Crossmember (Sport Model)” in Section 3D (“Front Suspension”).

Tightening torque
Crossmember bolt (a): 50 N·m (5.0 kg-m, 36.5 lb-ft)



4) Install both tie rod ends (1) to knuckles (2). Tighten each castle nut (3) until holes for split pin (4) align but within specified torque and then bend new split pin as shown.

Tightening torque
Castle nut (b): 43 N·m (4.3 kg-m, 31.5 lb-ft)

5) Be sure that steering wheel and both brake discs are all straight ahead driving state.

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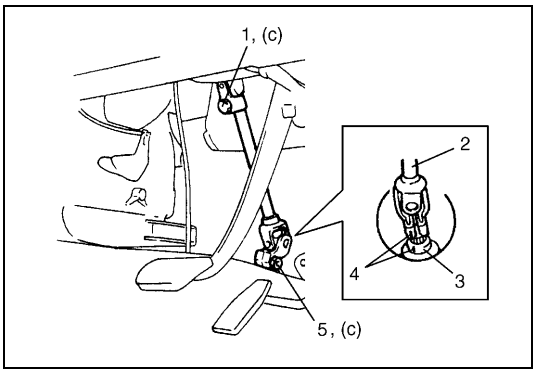
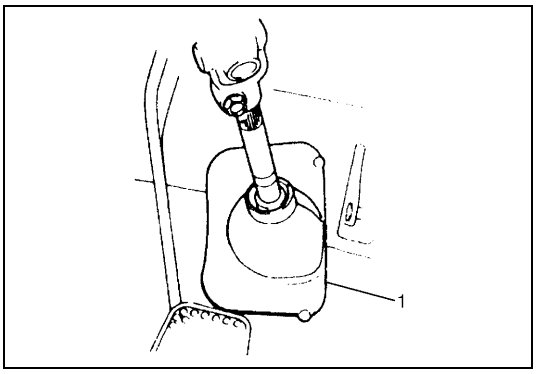


6) Align match marks (4) on steering lower joint (2) and pinion shaft (3) and then install steering lower joint to steering pinion shaft.
7) Tighten steering shaft joint bolts to specified torque (Lower side (5) first and then upper side (1)).

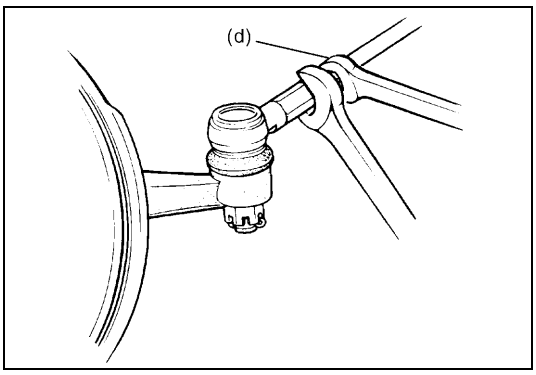
Tightening torque
Steering shaft joint bolt (c): 25 N·m (2.5 kg-m, 18.0 lb-ft)



8) Reinstall cover (1) removed previously to steering shaft joint.
9) Put back floor mat as it was.
10) Install both wheels and tighten wheel nuts to specified torque.

Tightening torque
Wheel nut: 85 N·m (8.5 kg-m, 61.5 lb-ft)

11) Lower hoist.
12) Check toe setting. Adjust as required (refer to “Toe Setting” in Section 3A).

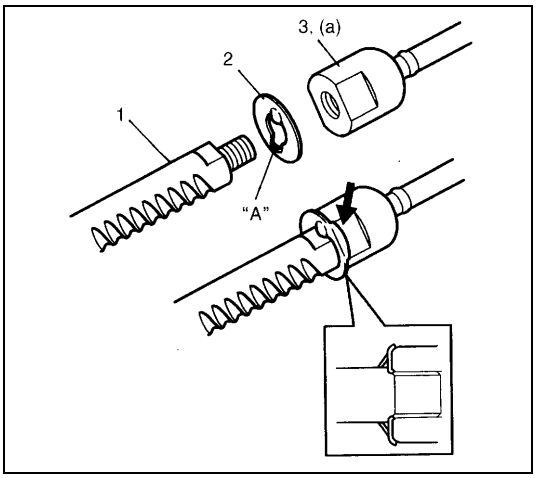


13) Tighten both tie rod end lock nuts to specified torque.

Tightening torque
Tie rod end lock nut (d): 45 N·m (4.5 kg-m, 32.5 lb-ft)

Rack Boot/Tie Rod

Installation



1) Install new tie rod lock washer (2) and tie rod (3) to rack (1). Align straight part “A” of washer with flat part of rack.

NOTE:

For correct installation of tie rod lock washer, referring to the figure.

2) Tighten tie rod inside ball nut to specified torque.

Tightening torque
Tie rod inside ball nut (a): 85 N·m (8.5 kg-m, 61.5 lb-ft)

3) Bend new lock washer to tie rod side as shown.

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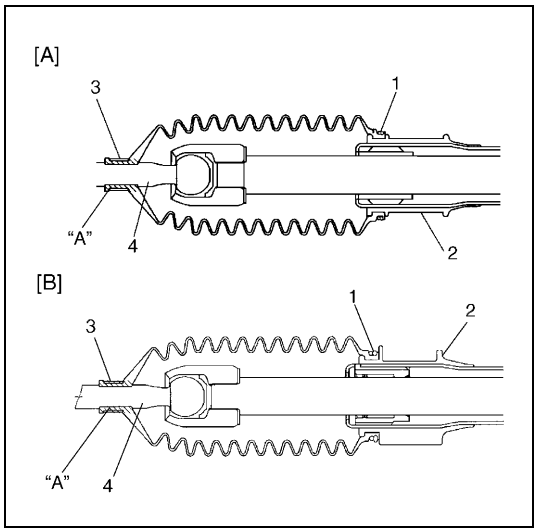
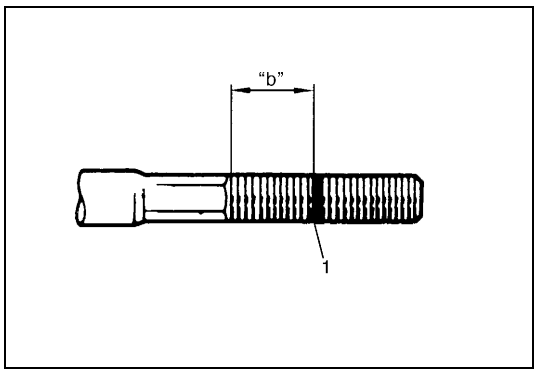


4) Position boot properly in grooves of gear case and tie rod (4) and clamp it with wire (1) and clip (3).
Wire should be new and should go around twice and be tightened with its both ends twisted together. The twisted ends should be bent in the circumferential direction.
After this, check to ensure that boot is free from twist and dent.

[A]:	Except sport model
[B]:	Sport model
2.	Rack side mount
"A":	Apply grease here.



5) Install tie rod end lock nut and tie rod end to tie rod.
Position lock nut to marking (1) made in removal.

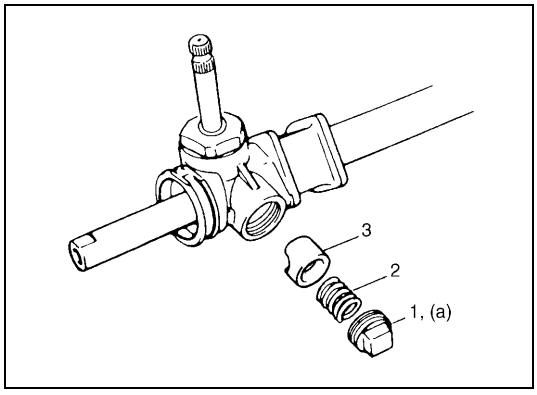
NOTE:

When tie rod end was replaced, measure length "b" on removed tie rod end and use it on new replacement tie rod end so as to position lock nut properly.

6) Install steering gear case referring to "Manual Rack and Pinion Assembly Installation" of this section.

Steering Rack Plunger

Installation



1) Apply grease lightly to sliding part of plunger against rack.

Grease: 99000-25050

2) Install rack plunger (3), rack plunger spring (2), rack damper screw (1) to steering case in direction shown. Tighten rack damper screw to specified torque.

Tightening torque
Rack damper screw (a): 12N·m (1.2 kg-m, 8.5 lb-ft)

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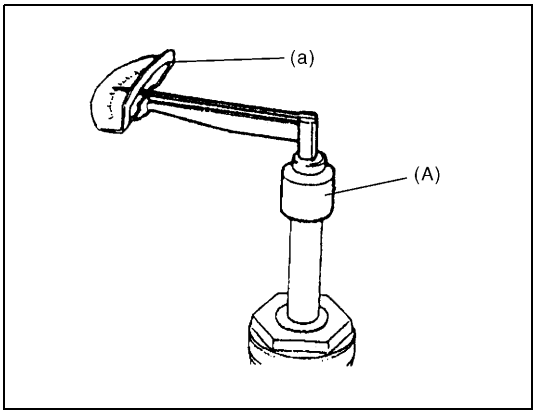
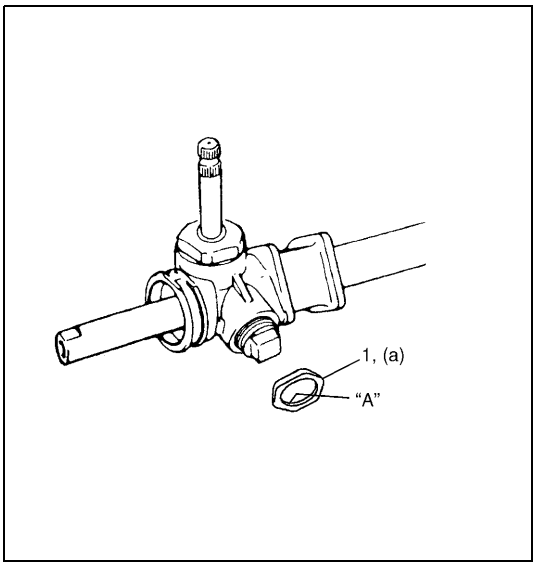


3) After tightening rack damper screw to specified torque, turn it back by 30° – 50° and check for rotation torque of pinion. If it is not as specified below, adjust so that it will be within specified torque range.
   Also, check if rack as a whole moves smoothly.

Special tool
(A): 09944-18211

Rotation Torquer of pinion
(a): 0.4 – 1.1 N·m (0.04 – 0.11 kg-m, 0.29 – 0.79 lb-ft)



4) Apply sealant to thread part of rack damper screw lock nut (1) and tighten it to specified torque by not turning damper screw position adjusted in step 3).

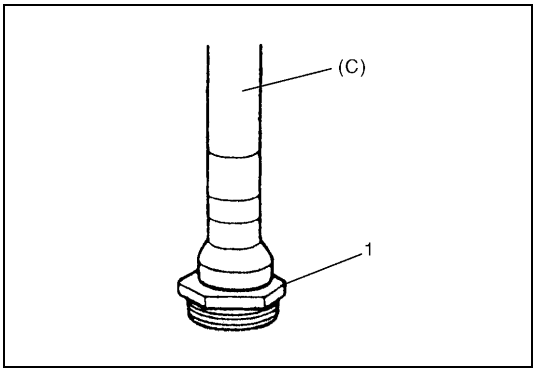
"A": Sealant 99000-31250

Tightening torque
Rack damper screw lock nut
(a): 40 N·m (4.0 kg-m, 29.0 lb-ft)

5) After adjustment, put rack damper screw cap as deeply as possible.
6) Install rack boots and tie rods referring to "Rack Boot/tie Rod Installation" in this section.
7) Install steering gear case referring to "Manual Rack And Pinion Assembly" in this section.

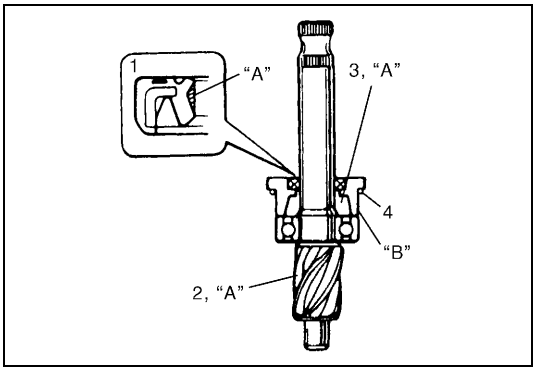
Steering Pinion

Installation



1) Install new oil seal with special tool to pinion bearing plug (1).

Special tool
(C): 09925-98210



2) Apply grease to all around pinion teeth (2), pinion needle bearing, gear case O-ring (4) and gear case oil seal lip (1). Fill inside of pinion bearing plug (3) with grease.

"A": Grease 99000-25050

3) Install pinion assembly into steering gear case.

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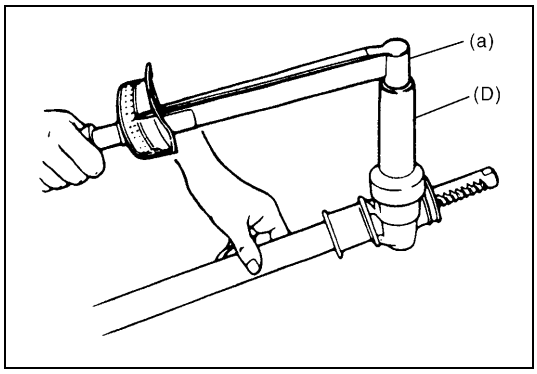


4) Tighten pinion bearing plug to specified torque.

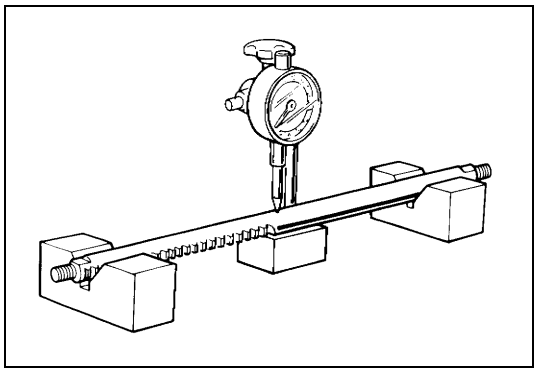
Tightening torque
Pinion bearing plug (a): 95 N·m (9.5 kg-m, 69.0 lb-ft)

Special tool
(D): 09944-26011

5) Install rack plunger referring to “Steering Rack Plunger” in this section.

Steering Rack

Inspection

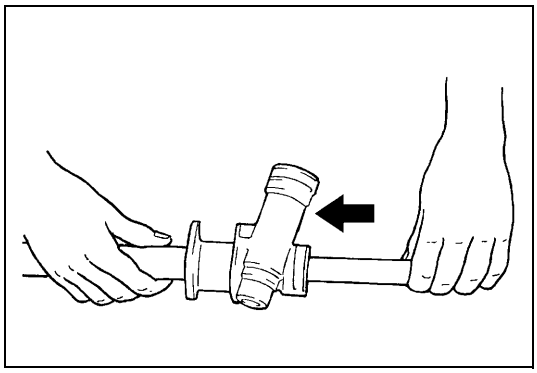


Inspect for deflection, teeth wear, or damage, back surface wear or damage.
If deflection exceeds limit, replace rack.

Limit of rack deflection: 0.4 mm (0.016 in.)

Installation

1) Apply grease to entire teeth surface of rack and its periphery.



2) Slide rack into steering gear case in the direction as shown.

CAUTION:
Inside of steering rack bushing is coated with special coating. As it is damageable, be very careful not to cause damage to it when inserting rack into steering gear case.

3) Install pinion assembly to gear case by performing Steps 2) – 4) in “Steering Pinion Installation” of this section.4)
4) Perform Step 1) – 4) of “Installation” under “Steering Rack Plunger” in this section.

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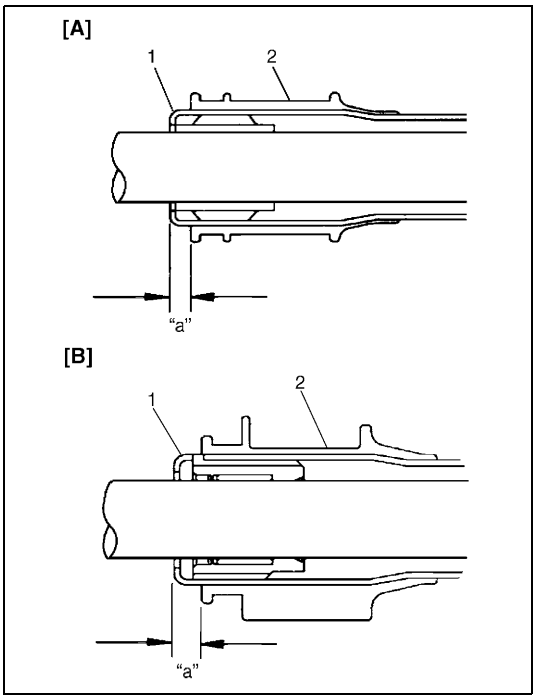


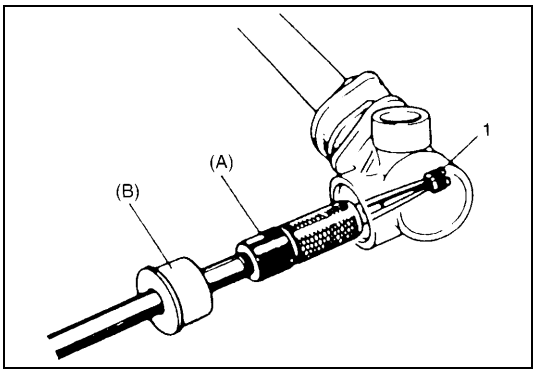
5) Before installing boot to steering rack housing (1), make sure that rack side mount (2) is positioned as shown. Install tie rods to rack by performing Steps 1) – 6) of "Installation" under "Rack Boot/Tie Rod Installation" in this section.

Rack side mount installing position
"a": 6.3 mm (0.25 in.) ····· [A]: Except sport model
"a": 7.3 mm (0.29 in.) ····· [B]: Sport model

Pinion Bearing

Removal

1) Remove rack from steering gear case, referring to "Steering Rack Removal" in this section.



2) Remove pinion bearing (1) from gear case with special tools as shown.

Special tool
(A): 09921-20200
(B): 09930-30104

Tightening Torque Specifications

Fastening part	Tightening torque		
	N•m	kg-m	lb-ft
Gear case mount bolt	25	2.5	18.0
Crossmember bolt	50	5.0	36.5
Castle nut	43	4.3	31.5
Steering shaft joint bolt	25	2.5	18.0
Wheel nut	85	8.5	61.5
Tie rod end lock nut	45	4.5	32.5
Tie rod inside ball nut	85	8.5	61.5
Rack damper screw lock nut	40	4.0	29.0
Pinion bearing plug	95	9.5	69.0

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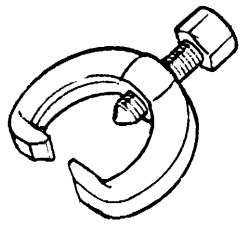
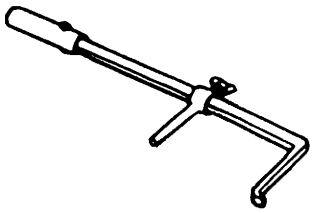
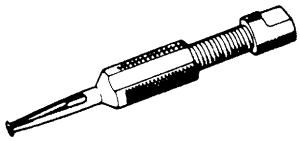
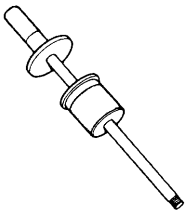
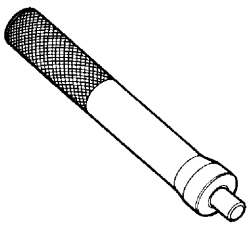
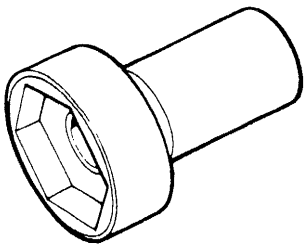
Required Service Material

Material	Recommended SUZUKI product (Part Number)	Use
Lithium Grease (Should be applicable for –40C° ~ 130°C)	SUZUKI SUPER GREASE (E) (99000-25050)	• Sliding part of rack against steering housing (All around rack plunger, rack bushing and rack) • Sliding part against steering pinion (Oil seal lip, needle bearing) • Steering rack and pinion gear teeth • Filled into pinion bearing cap • Contacting parts of tie-rod and rack side boots • Rack end ball joint
Sealant	SUZUKI BOND NO. 1207F (99000-31250)	• Rack damper screw lock nut thread

Special Tool

 09913-65210 Tie-rod end remover	 09913-50121 Oil seal remover	 09921-20200 Pinion bearing remover	 09925-98210 Bearing installer
 09930-30104 Sliding shaft	 09943-88211 Pinion bearing installer	 09944-18211 Pinion torque checking socket	 09944-26011 43 mm Socket (Pinion bearing plug remover)

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SECTION 3B1

ELECTRICAL POWER STEERING (P/S) SYSTEM

WARNING:

For vehicles equipped with a Supplemental Restraint (Air Bag) System :

- **Service on and around the air bag system components or wiring must be performed only by an authorized SUZUKI dealer. Refer to "Air Bag System Components and Wiring Location View" under "General Description" in the air bag system section in order to confirm whether you are performing service on or near the air bag system components or wiring. Please observe all WARNINGs and "Service Precautions" under "On-Vehicle Service" in the air bag system section before performing service on or around the air bag system components or wiring. Failure to follow WARNINGs could result in unintentional activation of the system or could render the system inoperative. Either of these two conditions may result in severe injury.**
- **Technical service work must be started at least 90 seconds after the ignition switch is turned to the "LOCK" position and the negative cable is disconnected from the battery. Otherwise, the system may be activated by reserve energy in the Sensing and Diagnostic Module (SDM).**

NOTE:

For the items with asterisk (*) in the content below, refer to the same section of the service manual mentioned in the foreword of this manual.

CONTENTS

General Description ..... *
- System Components ..... *
- Wiring Diagram 3B1-3

Diagnosis ..... *
- On-board Diagnostic System ..... *
- Precautions in Diagnosing Troubles ..... *
- System Check Flow Table ..... *
- Malfunction Indicator Lamp ("EPS" Warning Lamp) Check ..... *
- DTC Check ..... *
- DTC Clearance ..... *
- Serial Data Link Circuit Check ..... *
- DTC Table ..... *
- Table A - Malfunction Indicator Lamp Does Not Come ON at Ignition Switch ON But Leaving Engine OFF ..... *
- Table B - Malfunction Indicator Lamp Flashes at Ignition Switch ON ..... *
- Table C - Malfunction Indicator Lamp Does Not Flash, Just Remains ON or Just Remains OFF Even with Diagnosis Switch Terminal Grounded ..... *
- DTC C1111 (DTC No.11) Torque Sensor Main Circuit Failure ..... *
- DTC C1113 (DTC No.13) Torque Sensor Main and Sub Circuit Failure ..... *
- DTC C1115 (DTC No.15) Torque Sensor Sub Circuit Failure ..... *
- DTC C1114 (DTC No.14) Torque Sensor 5V Power Supply Circuit Failure ..... *
- DTC C1116 (DTC No.16) Torque Sensor 8V Power Supply Circuit Failure ..... *
- DTC C1121/C1123/C1124 (DTC No.21/23/24) VSS Circuit Failure ..... *
- DTC C1122 (DTC No.22) Engine Speed Signal Circuit Failure ..... *
- DTC C1141/C1142/C1143/C1144/ C1145 (DTC No.41/42/43/44/45) Motor Circuit Failure ..... *
- DTC C1151 (DTC No.51) Clutch Circuit Failure ..... *
- DTC C1153 (DTC No.53) P/S Control Module Power Supply Circuit Failure ..... *
- DTC C1152/C1154/C1155 (DTC No.52/54/55) P/S Control Module Failure ..... *
- Trouble Diagnosis (for Trouble Not Indicated by On Board Diagnostic System) ..... *

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Inspection of P/S Control Module and Its Circuits ..... *
Steering Wheel Play Inspection ..... *
Steering Force Inspection ..... *
On-vehicle Service ..... *
P/S Control Module ..... *
Torque Sensor ..... *
Motor and Clutch ..... *
Steering Column Assembly ..... *
Special Tool ..... *

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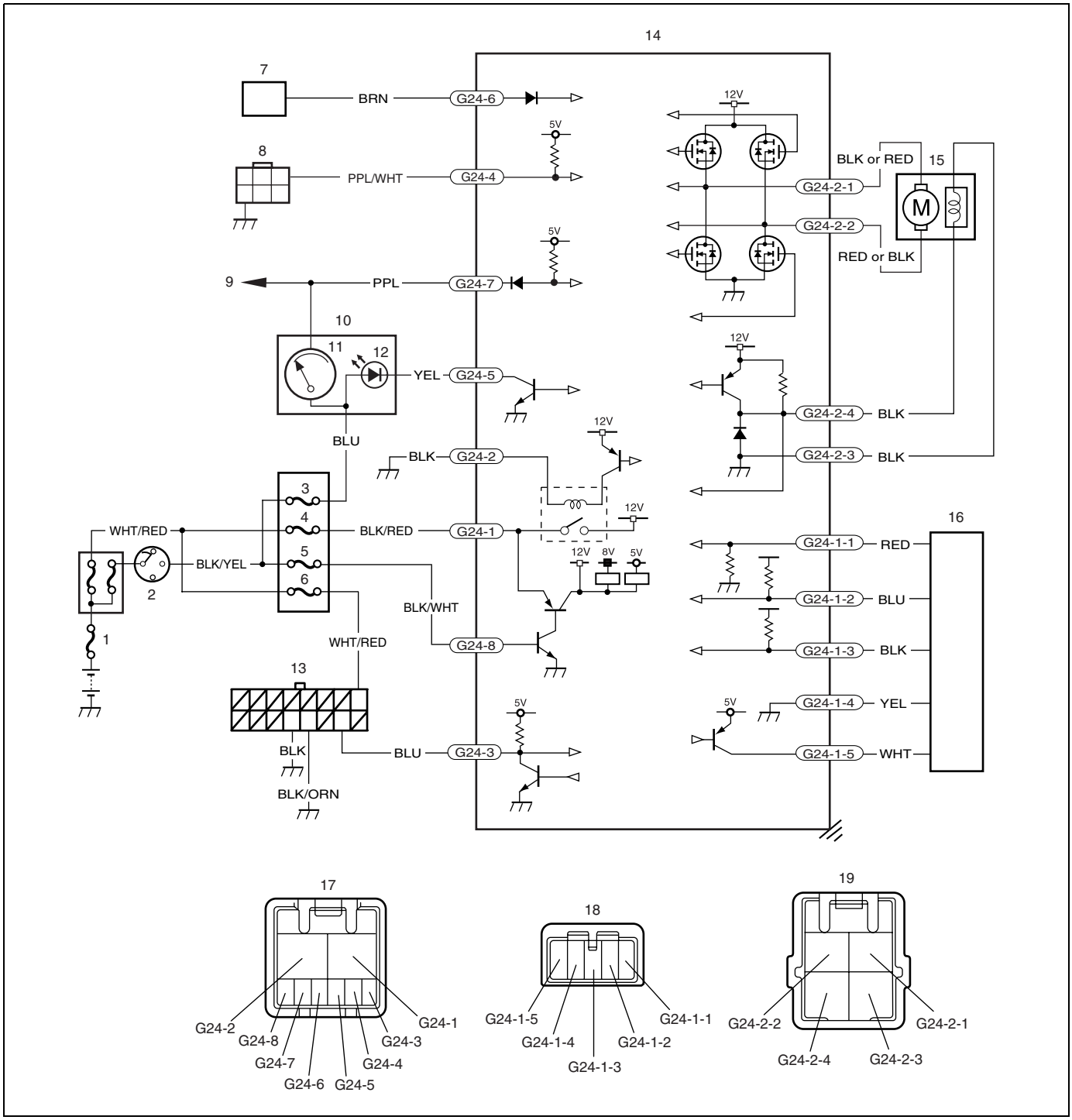
Wiring Diagram



1. Battery	8. Diagnosis connector	15. Motor and clutch
2. Ignition switch	9. To vehicle speed sensor (VSS)	16. Torque sensor
3. “METER” fuse (10 A)	10. Combination meter	17. Connector “G24”
4. “P/S” fuse (30 A)	11. Speedometer	18. Connector “G24-1”
5. “IG” fuse (15 A)	12. “EPS” warning lamp	19. Connector “G24-2”
6. “RADIO DOME” fuse (15 A)	13. Data link connector	
7. ECM	14. P/S control module	

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SECTION 3D

FRONT SUSPENSION

NOTE:

- **All front suspension fasteners are an important attaching part in that it could affect the performance of vital parts and systems, and/or could result in major repair expense. They must be replaced with one of the same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of this part.**
- **Never attempt to heat, quench or straighten any front suspension part. Replace it with a new part or damage to the part may result.**
- **For the items with asterisk (*) in the "CONTENTS" below, refer to the same section of the Service Manual mentioned in "FOREWORD" of this manual.**

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Strut Assembly Check ..... *
Suspension Control Arm / Steering Knuckle Check ..... *
Suspension Control Arm Bushing Check ..... *
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Front Suspension Fasteners Check ..... *
Wheel Disc, Nut and Bearing Check ..... *
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Stabilizer Bar and/or Bushings ..... *
Wheel Hub and Steering Knuckle 3D-5
Suspension Control Arm / Bushing ..... *
Crossmember (Sport Model) 3D-9
Tightening Torque Specifications 3D-10
Required Service Material 3D-10
Special Tool 3D-11

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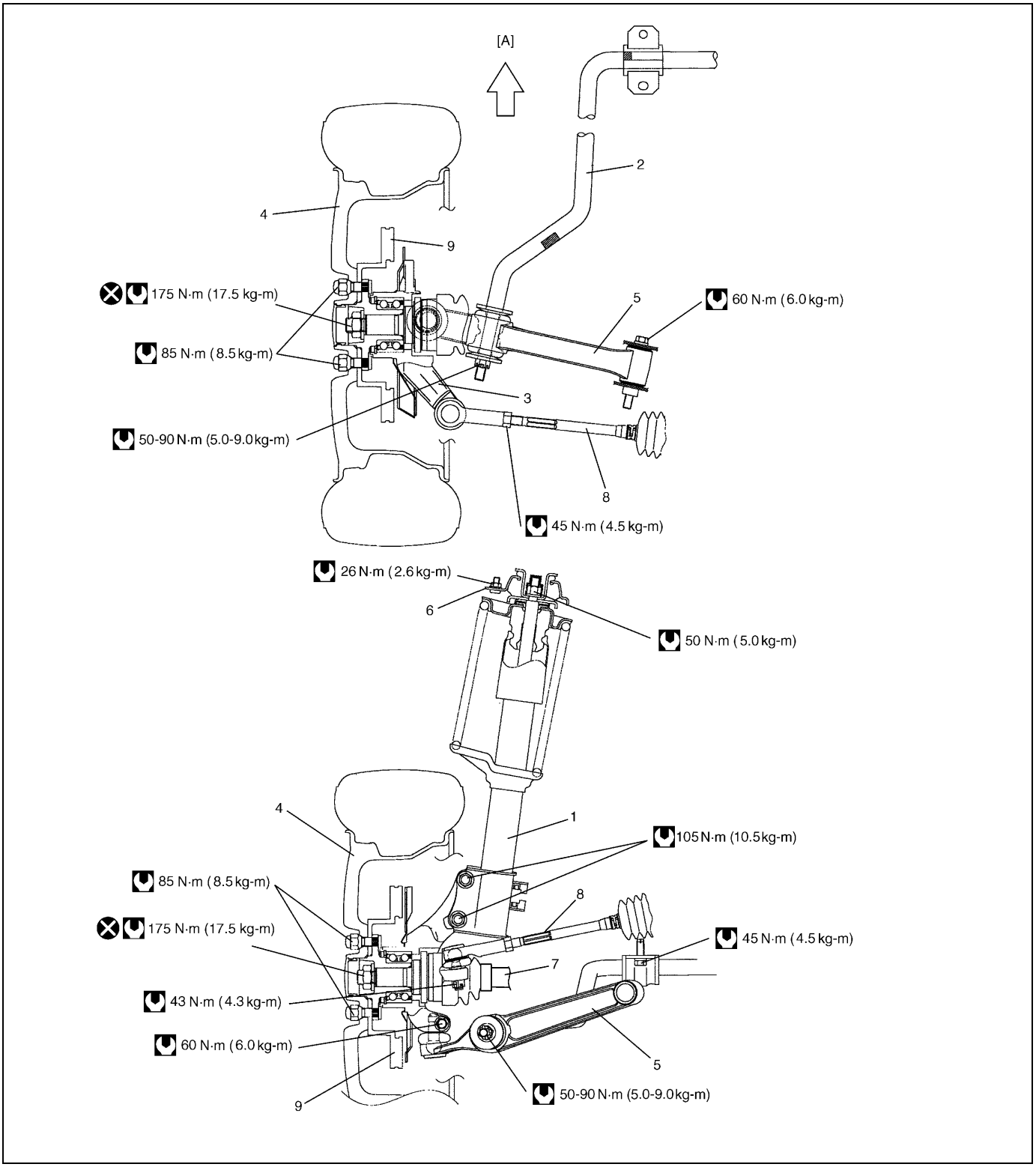
General Description

Front Suspension Component Locator

Sport model



1. Strut assembly	4. Wheel	7. Drive shaft	[A] : Front
2. Stabilizer bar	5. Suspension control arm	8. Tie rod	Tightening torque
3. Steering knuckle	6. Vehicle body	9. Brake disc	Do not reuse.

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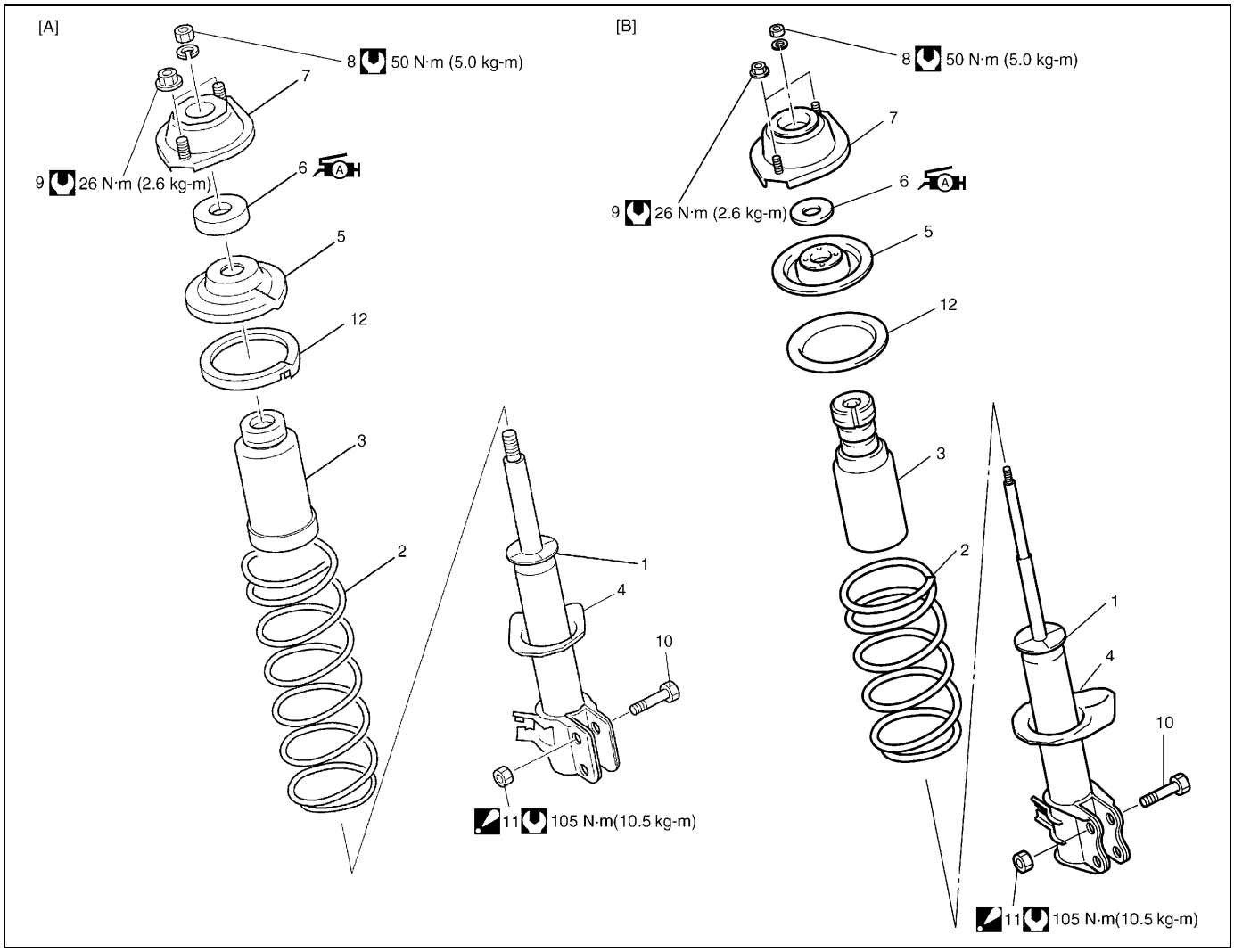
On-vehicle Service

Strut Assembly



[A]: Except Sport model		4. Coil spring lower seat	9. Strut support nut
[B]: Sport model		5. Coil spring upper seat	10. Strut bracket bolt : Insert from vehicle rear side.
1. Strut assembly		6. Strut bearing : Apply grease (99000-25010) to all around bearing.	11. Strut bracket nut
2. Coil spring		7. Strut support	12. Spring rubber seat
3. Bump stopper		8. Strut nut	Tightening torque

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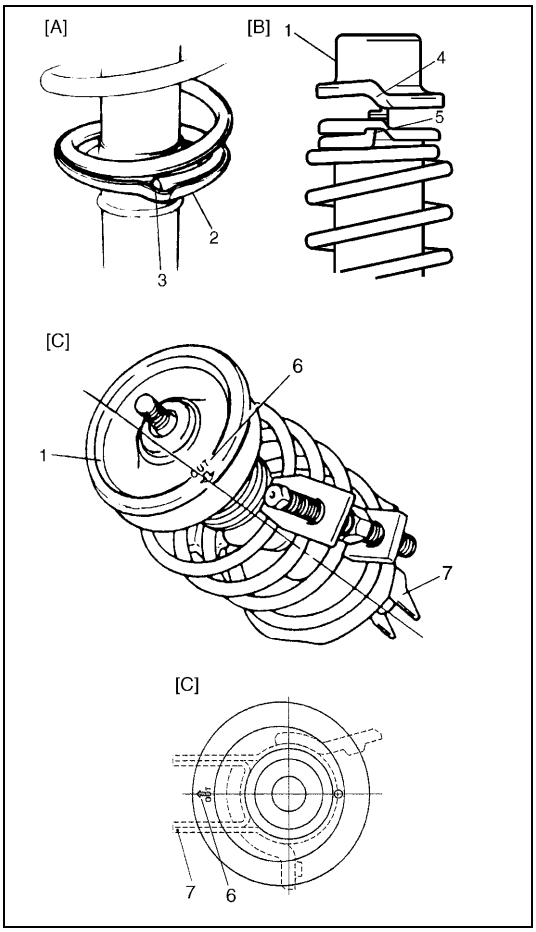
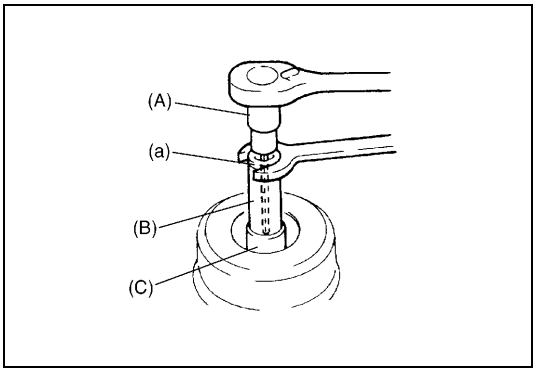
Assembly

For assembly, reverse disassembly procedure, noting the following instructions.



- Mate spring end with stepped part (3) of spring lower seat (2) as shown.
- Except sport model:
  Install spring upper seat (1), mating stepped part (4) of seat with spring upper end (5) as shown.
- Sport model:
  Install spring upper seat (1) on coil spring, aligning the "OUT" mark (6) on spring upper seat with the center of strut bracket (7).

[A] Lower seat
[B] Upper seat for except sport model
[C] Upper seat for sport model



- Tighten strut nut to specified torque by using special tools.

Tightening torque
Strut nut (a) : 50 N·m (5.0 kg-m, 36.5 lb-ft)

Special tool
(A): 09900-00411
(B): 09900-00414
(C): 09945-26010

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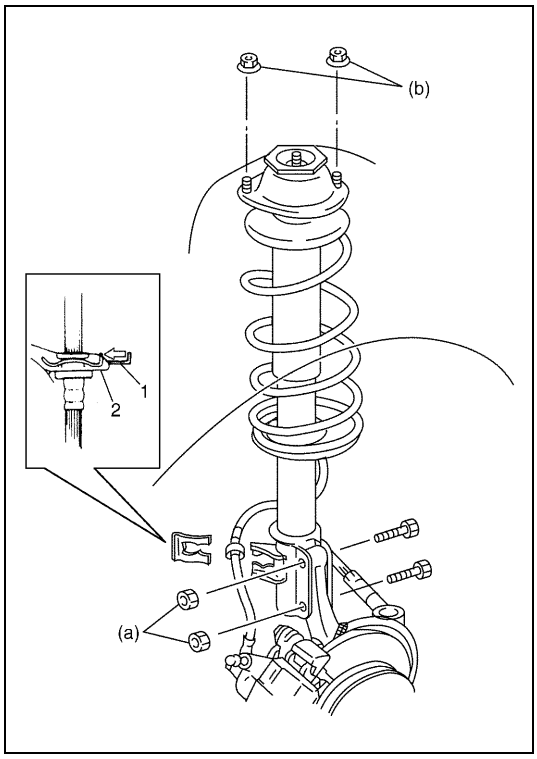
Installation

Install strut assembly by reversing removal procedure, noting the following instructions.



- Insert bolts in such direction as shown in figure.
- Tighten all fasteners to specified torque.

Tightening torque
Strut bracket nut (a): 105 N·m (10.5 kg-m, 76.0 lb-ft)
Strut support nut (b): 26 N·m (2.6 kg-m, 19.0 lb-ft)

NOTE:

- **Don't twist brake hose when installing it.**
- **Install E-ring (1) as far as it fits to bracket (2) as shown in figure.**

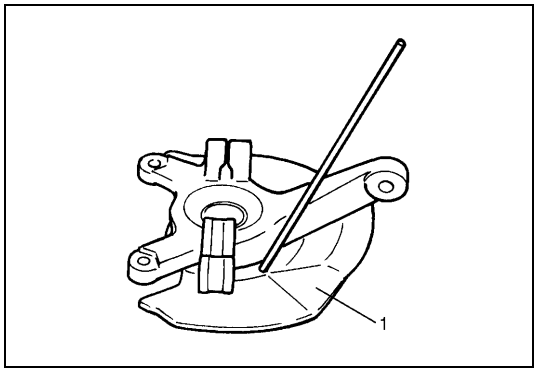
- Tighten wheel nut to specified torque.

Tightening torque
Wheel nut: 85 N·m (8.5 kg-m, 61.5 lb-ft)

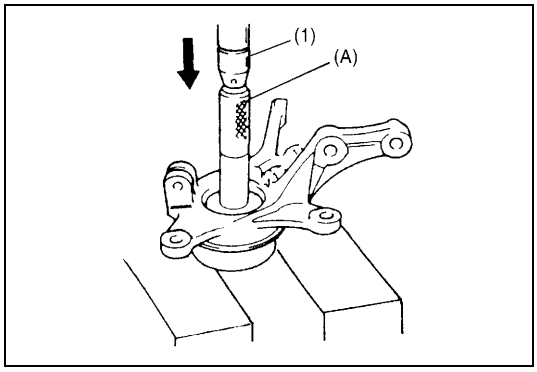
- After installation, confirm front wheel alignment referring to Section 3A.

Wheel Hub and Steering Knuckle

Disassembly



1) Uncaulk and remove dust cover (1).



2) Remove wheel bearing circlip.
3) Using hydraulic press (1) and special tool, remove wheel bearing.

Special tool
(A): 09913-75810 (Except sport model)
(A): 09913-75520 (Sport model)

CAUTION:
When installing wheel bearing, replace it with new one.

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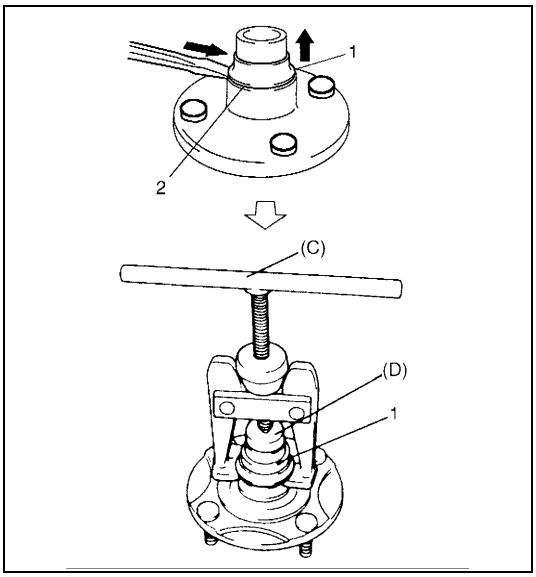
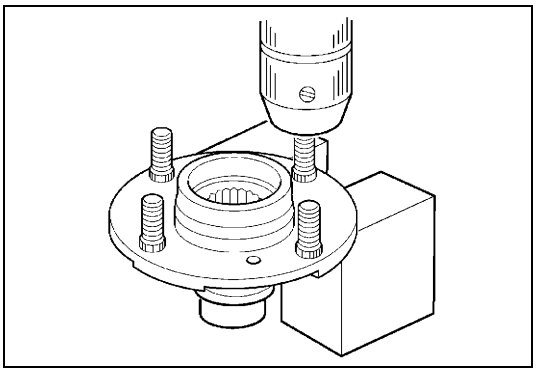


4) Remove wheel bearing outside inner race (1) as shown by hammering lightly at 3 locations around it so as not to cause damage to seating part (2) of wheel hub.

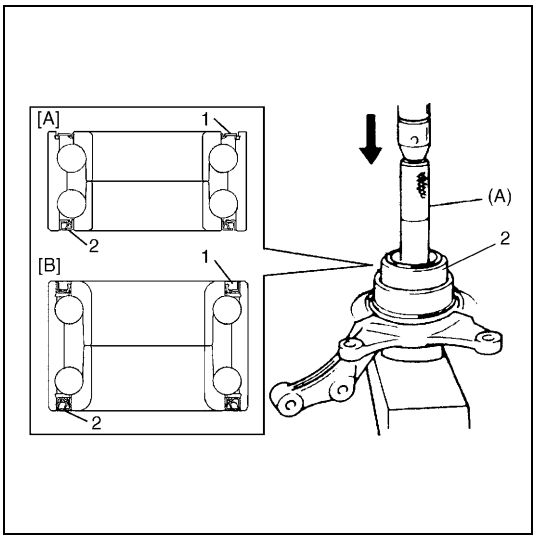
Special tool
(C): 09913-61110
(D): 09925-88210



5) Remove hub bolts (1) with hydraulic press or copper hammer.

CAUTION:
Never remove bolt unless replacement is necessary.
Be sure to use a new bolt for replacement.

Assembly



1) Face grooved rubber seal side (1) of new wheel bearing (2) upward as shown in figure and press-fit it into knuckle using special tool.

Special tool
(A): 09913-75520 (Except sport model)
(A): 09913-75510 (Sport model)

CAUTION:
When replacing bearing, inner races or outer race, be sure to replace them with new ones as a set.

[A]	Sport model
[B]	Except sport model
2.	Stainless plate

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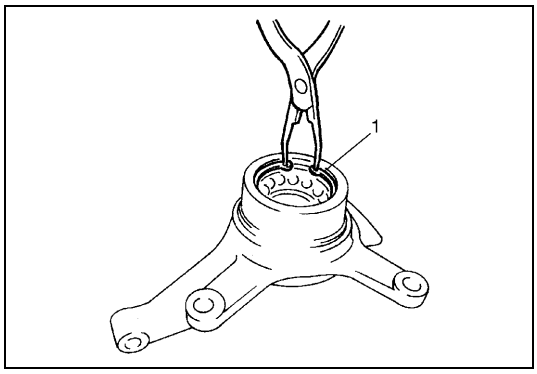
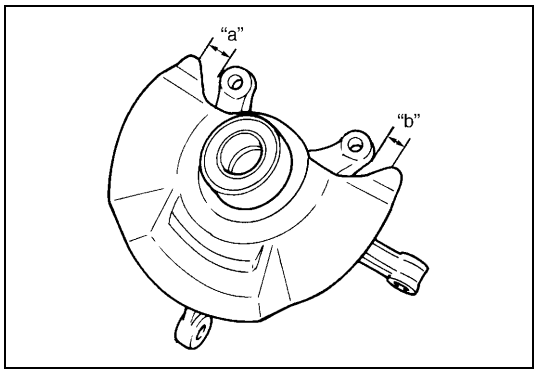
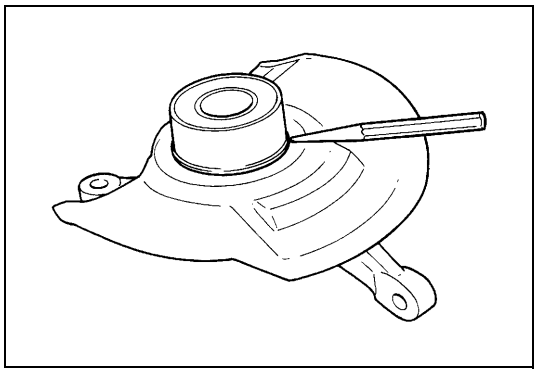


2) Install circlip (1).

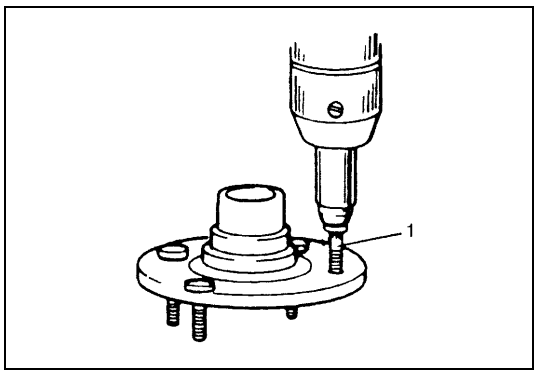


3) Drive in dust cover so that dimensions "a" and "b" become equal as shown in figure.

CAUTION:
When drive in dust cover, be careful not to deform it.



4) Caulk with a punch.



5) Insert new stud bolt (1) in hub hole. Rotate stud bolt slowly to assure that serrations are aligned with those made by original bolt.

Installation

For installation, reverse removal procedure, noting the following instructions.

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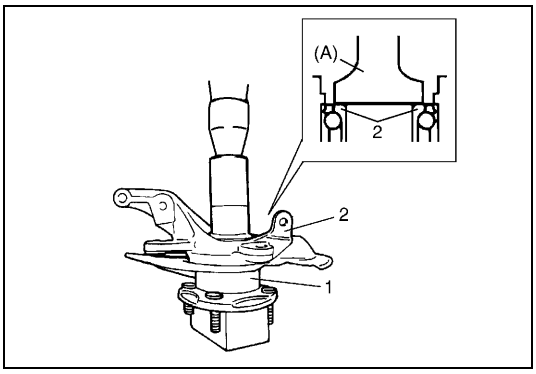
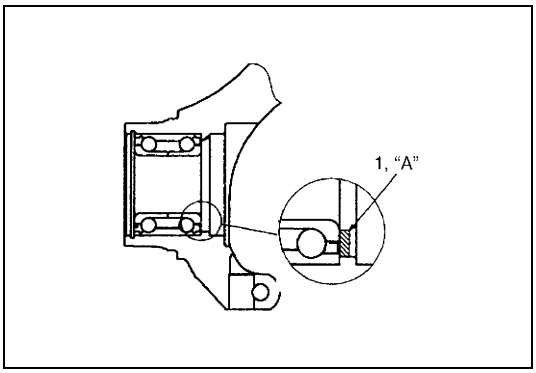


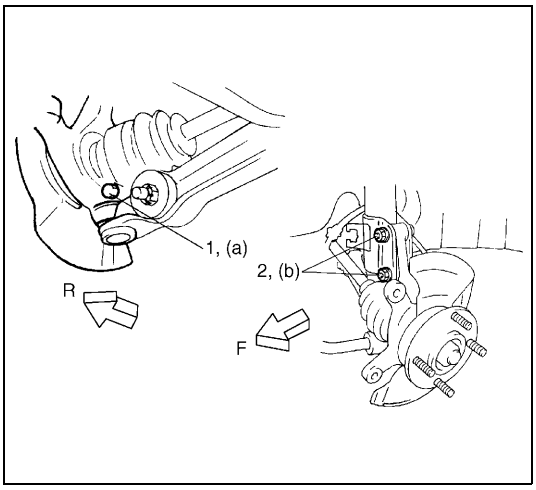
- Using special tool and hydraulic press, press-fit wheel hub (1) into wheel bearing (2).

Special tool
(A): 09913-75810



- Apply grease lightly to contact part (1) of wheel bearing and drive shaft.

"A": Grease 99000-25050



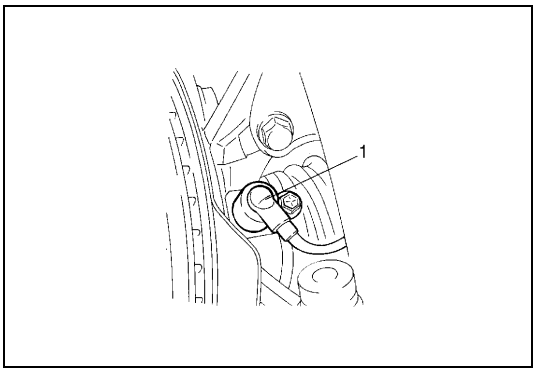
- Install ball joint bolt (1) from the direction as shown.
- Tighten suspension arm ball joint bolt (1) to specified torque.

Tightening torque
Suspension arm ball joint bolt
(a): 60 N·m (6.0 kg-m, 43.5 lb-ft)

- Tighten strut bracket nuts (2) to specified torque.

Tightening torque
Strut bracket nut (b): 105 N·m (10.5 kg-m, 76.0 lb-ft)

F:	Forward
R:	Rearward



- Install wheel speed sensor (1) (if equipped with ABS).

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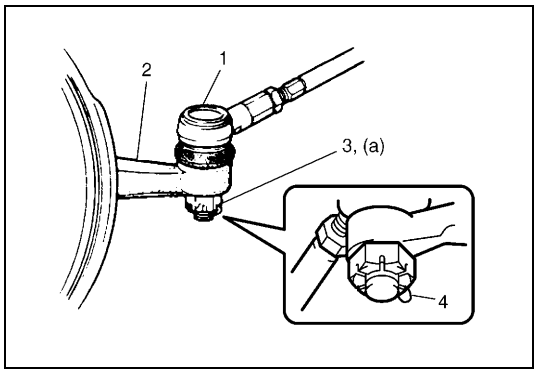
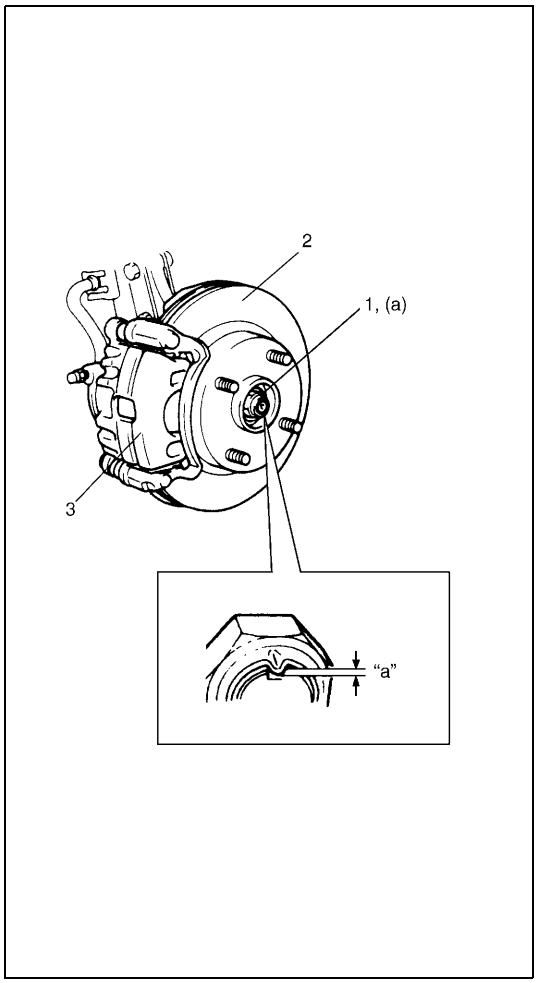


- Connect tie rod end (1) to steering knuckle (2) and tighten tie rod end castle nut (3) to specified torque.

Tightening torque
The rod end castle nut (a): 43 N·m (4.3 kg-m, 31.5 lb-ft)

- Install new split pin (4).



- Install brake disc (2) and brake caliper (3).
- Tighten brake caliper bolt to specified torque.

Tightening torque
Brake caliper bolt: 85 N·m (8.5 kg-m, 61.5 lb-ft)

- Depress foot brake pedal and hold it there.
  Tighten new drive shaft nut (1) to specified torque.

Tightening torque
Drive shaft nut (a): 175 N·m (17.5 kg-m, 127.0 lb-ft)

CAUTION:
Never reuse drive shaft nut (1).

- Caulk drive shaft nut (1) as shown.

Caulking specification
"a": 0.5 mm (0.02 in.) or more

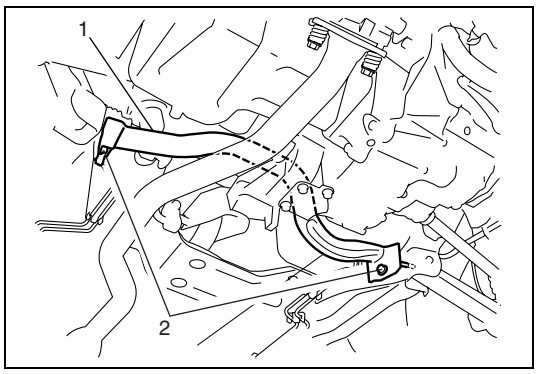
CAUTION:
Be careful while caulking nut so that no crack will occur in caulked part of nut. Cracked nut must be replaced with new one.

- Tightening wheel nut to specified torque.

Tightening torque
Wheel nut: 85 N·m (8.5 kg-m, 61.5 lb-ft)

Crossmember (Sport Model)

Removal



1) Hoist vehicle.
2) Remove crossmember bolts (2).
3) Remove crossmember (1).

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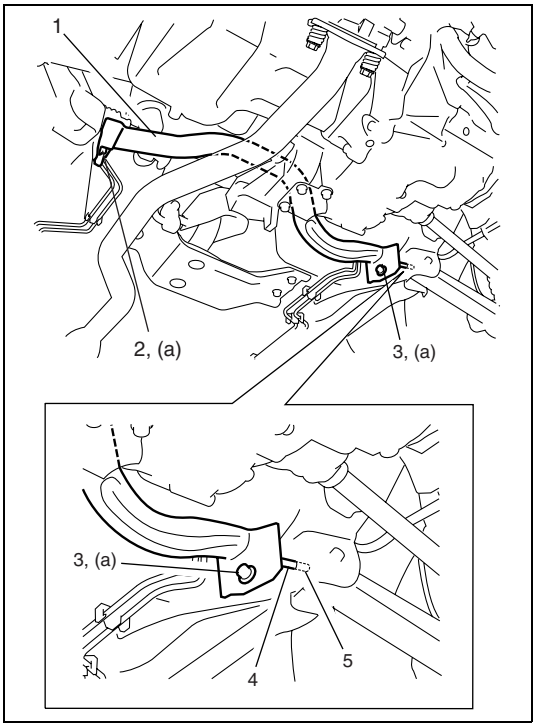

Installation

1) Pass crossmember (1) through above rear engine mounting from left side of body.
2) Insert positioning pin (4) into hole (5).
3) Tighten new bolt (2) temporarily.
4) Tighten new bolt (3) to specified torque. Do not let crossmember (1) interfere with steering gear box.
5) Tighten bolt (2) to specified torque.

Tightening torque
Crossmember bolt (a): 50 N·m (5.0 kg-m, 36.5 lb-ft)

CAUTION:
Do not reuse crossmember bolts (2), (3).

Tightening Torque Specifications

Fastening part	Tightening torque		
	N•m	kg-m	lb-ft
Strut nut	50	5.0	36.5
Strut bracket nut	105	10.5	76.0
Strut support nut	26	2.6	19.0
Wheel nut	85	8.5	61.5
Suspension arm ball joint bolt	60	6.0	43.5
The rod end castle nut	43	4.3	31.5
Brake caliper bolt	85	8.5	61.5
Drive shaft nut	175	17.5	127.0
Crossmember bolt	50	5.0	36.5

Required Service Material

Material	Recommended SUZUKI product (Part Number)	Use
Lithium grease	SUPER GREASE (A) (99000-25010)	• Strut bearing
Lithium grease	SUPER GREASE (E) (99000-25050)	• Contact part of wheel bearing and drive shaft.

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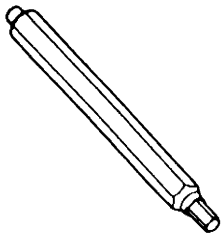
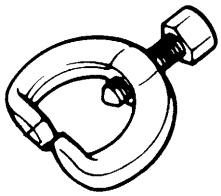
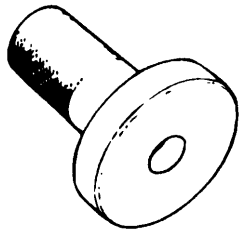
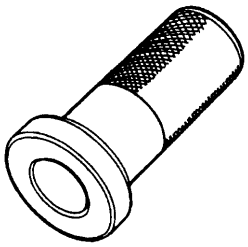
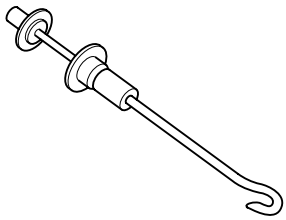
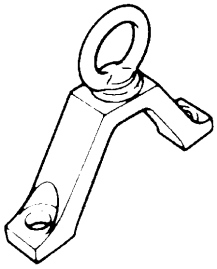
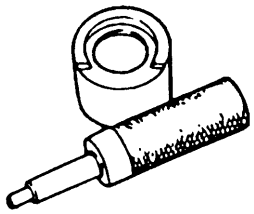
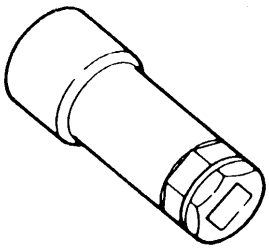
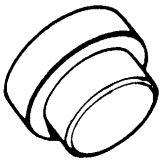
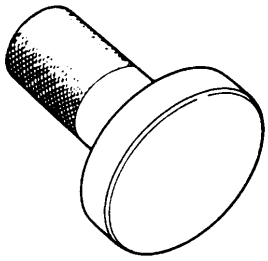
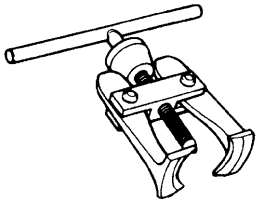
Special Tool

 09900-00411 Hexagon wrench socket	 09900-00414 Hexagon wrench bit 6 mm	 09913-65210 Tie rod end remover	 09913-75520 Bearing installer
 09913-75810 Bearing installer	 09942-15511 Sliding hammer	 09943-17912 Front wheel hub remover	 09943-77910 Bushing remover
 09945-26010 Socket wrench 17 mm	 09925-88210 Bearing puller attachment	 09913-75510 Bearing installer (Sport model)	 09913-61110 Bearing puller

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SECTION 3E

REAR SUSPENSION

NOTE:

- **All suspension fasteners are an important attaching part in that it could affect the performance of vital parts and systems, and/or could result in major repair expense. They must be replaced with one of the same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of this part.**
- **Never attempt to heat, quench or straighten any suspension part. Replace it with a new part, or damage to the part may result.**
- **For the items with asterisk (*) in the "CONTENTS" below, refer to the same section of the Service Manual mentioned in "FOREWORD" of this manual.**

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Bump Stopper/Spring Upper Seat Check ..... *
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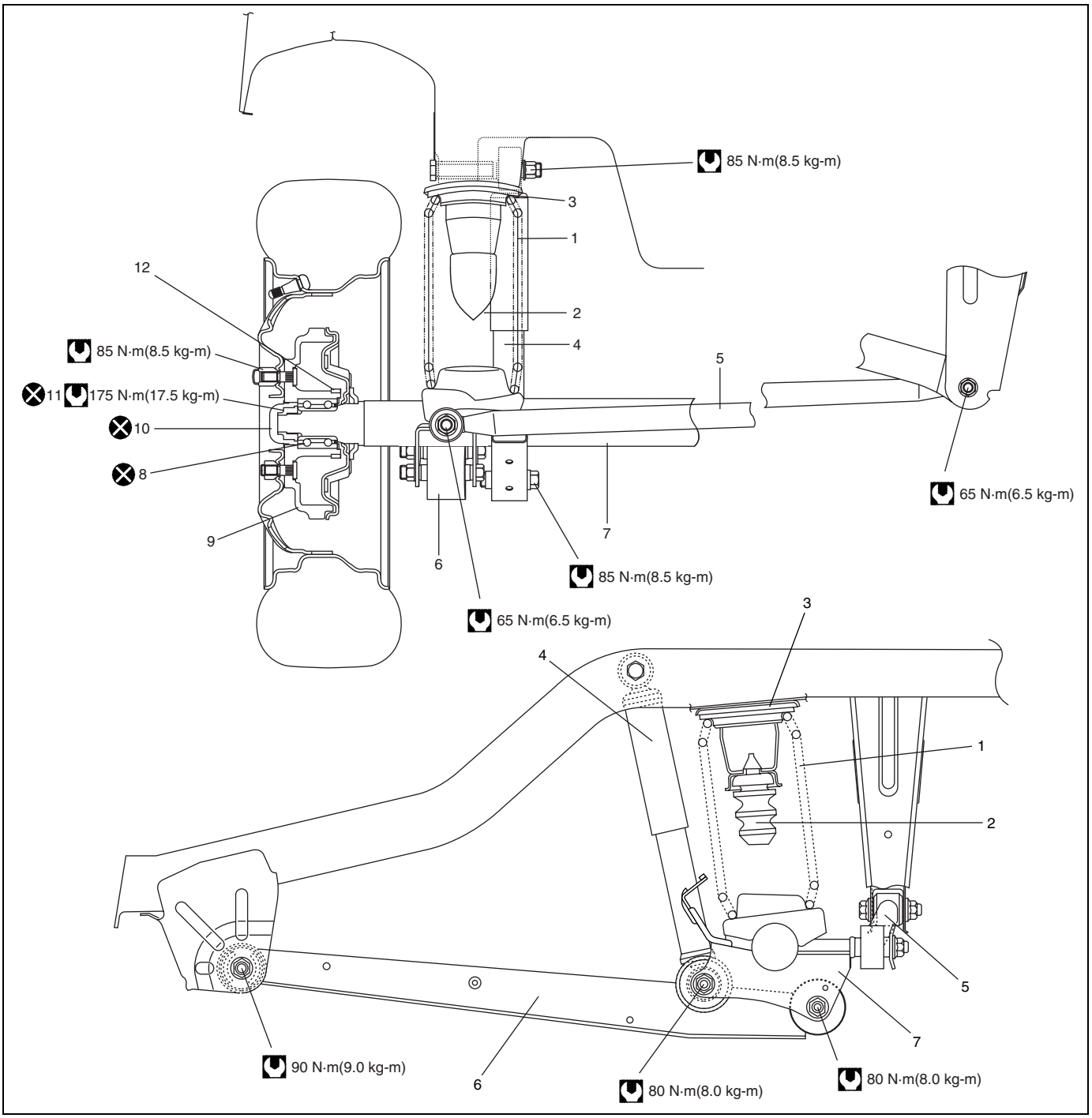
General Description

Rear suspension is Isolated Trailing Link (I.T.L.) type which consists of coil springs, rear axle, rear axle housing, shock absorbers, lateral rod and trailing arms.

Rear Suspension Component Construction

2WD vehicle (Except sport model)



1. Rear coil spring	5. Lateral rod	9. Brake drum	Tightening torque
2. Rear bump stopper	6. Trailing arm	10. Spindle cap	Do not reuse.
3. Rear spring upper seat	7. Rear axle	11. Spindle nut	
4. Rear shock absorber	8. Wheel Bearing	12. Rear wheel sensor ring (if equipped with ABS)	

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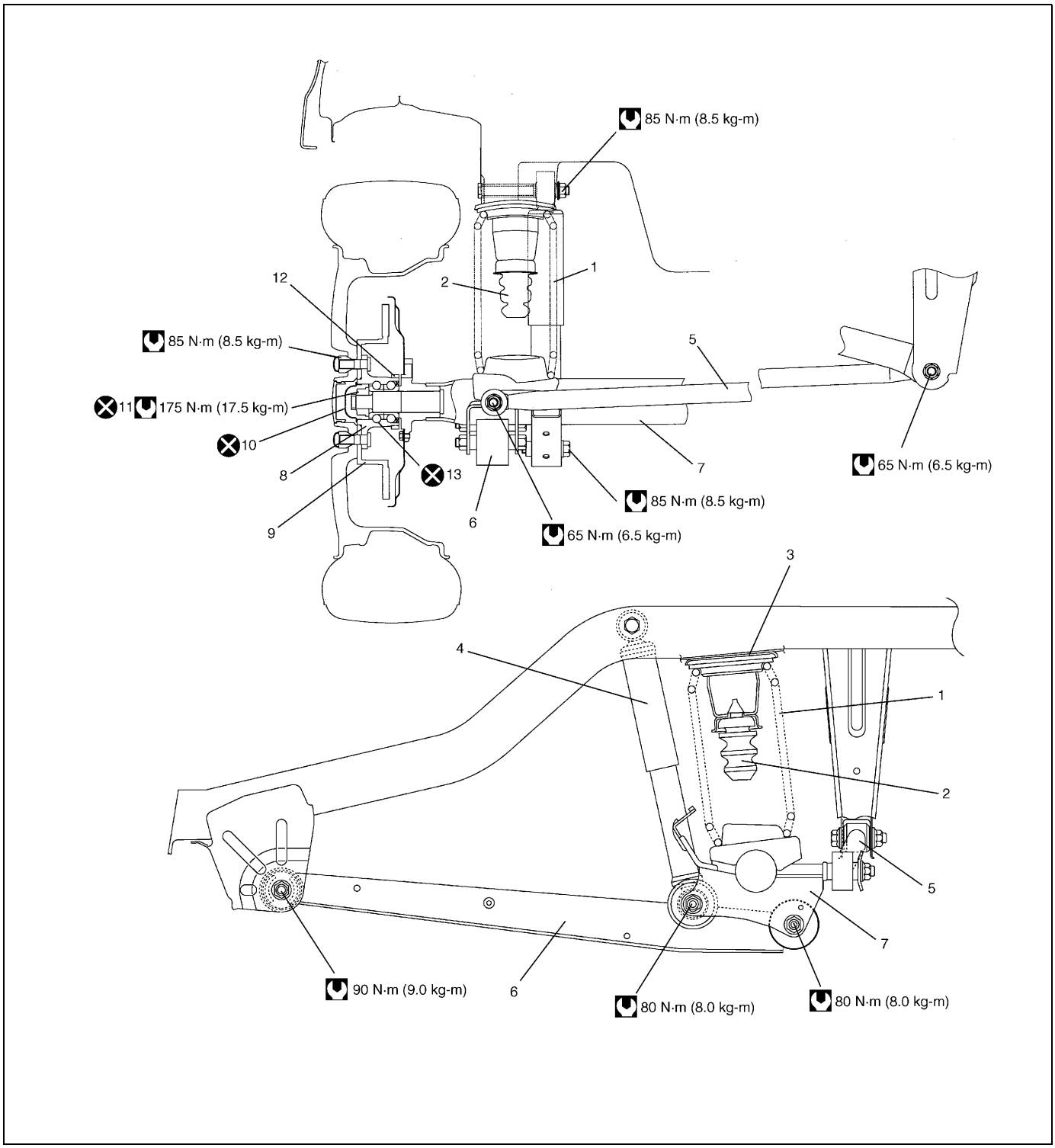
2WD vehicle (Sport model)



1. Rear coil spring	5. Lateral rod	9. Brake disc	13. Wheel bearing
2. Rear bump stopper	6. Trailing arm	10. Spindle cap	Tightening torque
3. Rear spring upper seat	7. Rear axle	11. Rear axle nut	Do not reuse.
4. Rear shock absorber	8. Wheel hub	12. Rear wheel sensor ring (if equipped with ABS)	

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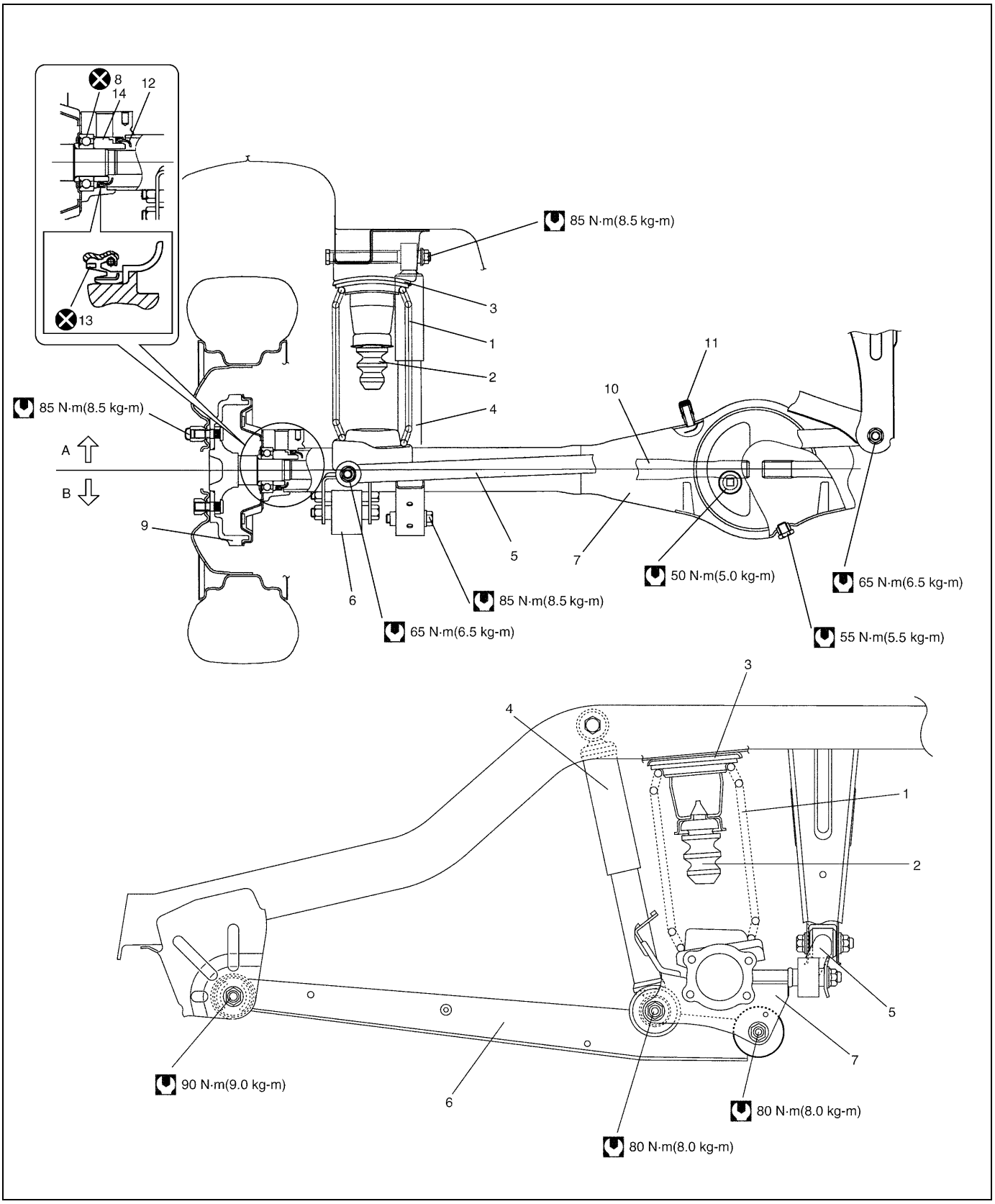
4WD vehicle (Except sport model)



A: With ABS	3. Rear spring upper seat	7. Rear axle housing	11. Breather cap	Tightening torque
B: Without ABS	4. Rear shock absorber	8. Wheel bearing	12. Oil seal protector	Do not reuse.
1. Rear coil spring	5. Lateral rod	9. Brake drum	13. Oil seal	
2. Rear bump stopper	6. Trailing arm	10. Rear axle shaft	14. Wheel bearing retainer ring	

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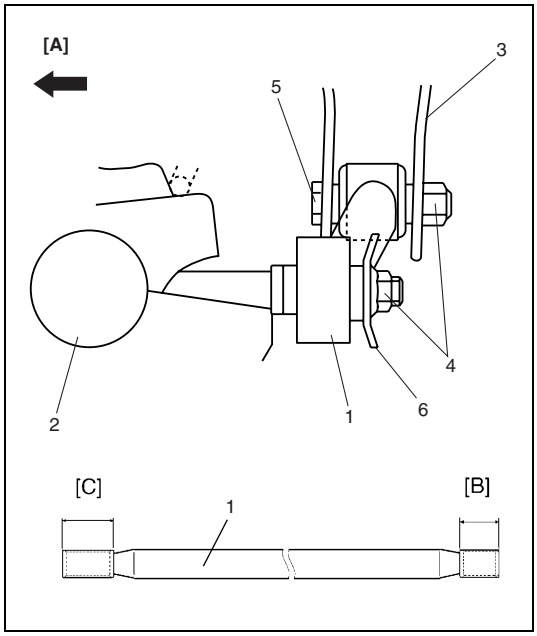
On-vehicle Service

Lateral Rod

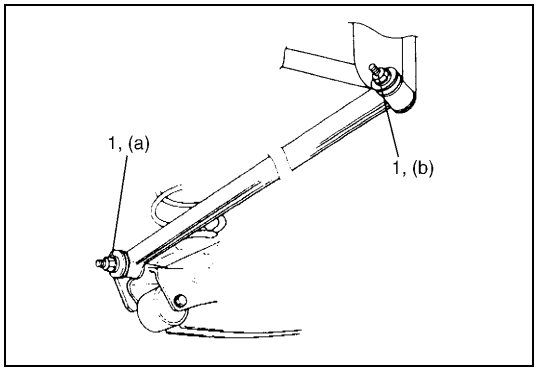
Installation



1) Install lateral rod (1) to rear axle (2) and vehicle body (3) referring to figure for proper installing direction of nuts (4), bolt (5) and washer (6).
   Tighten nuts (4) temporarily at this step.

[A] :	Front
[B] :	Body side (34 mm, 1.34 in.)
[C] :	Rear axle side (45 mm, 1.77 in.)

2) Lower hoist.

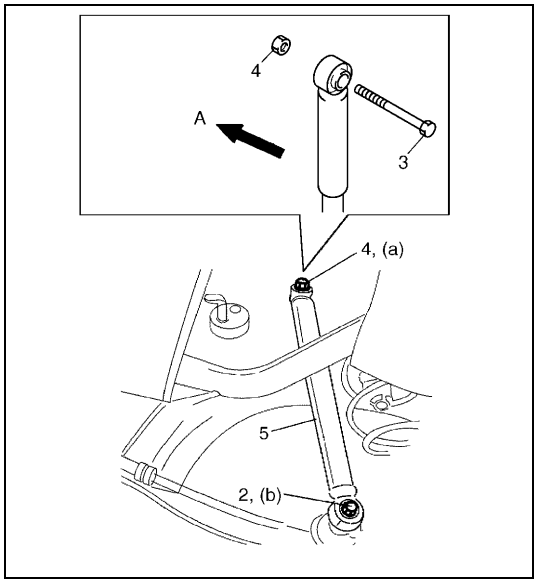


3) Tighten lateral rod nuts (1) to specified torque. It is the most desirable to have vehicle off hoist and in no-loaded condition when tightening rod nuts.

Tightening torque
Lateral rod axle housing side nut
(a): 65 N·m (6.5 kg-m, 47.0 lb-ft)
Lateral rod body side nut (b): 65 N·m (6.5 kg-m, 47.0 lb-ft)

Rear Shock Absorber

Installation



1) Install shock absorber (5) referring to the figure.
   Tighten bolt and nut temporarily at this step.
2) Remove floor jack from rear axle and lower hoist.
3) Tighten bolt and nut to specified torque.

Tightening torque
Rear shock absorber upper nut
(a): 85 N·m (8.5 kg-m, 61.5 lb-ft)
Rear shock absorber lower bolt
(b): 85 N·m (8.5 kg-m, 61.5 lb-ft)

A :	Center of vehicle

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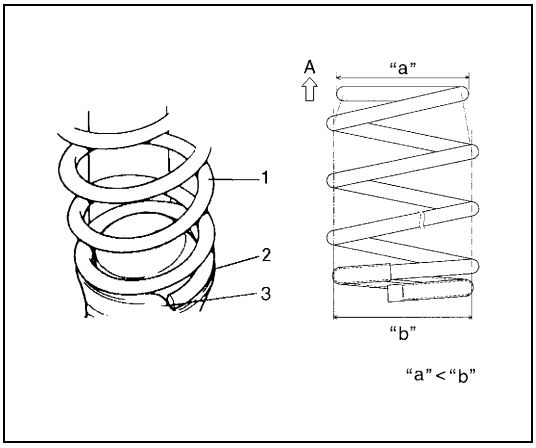
Coil Spring

Installation

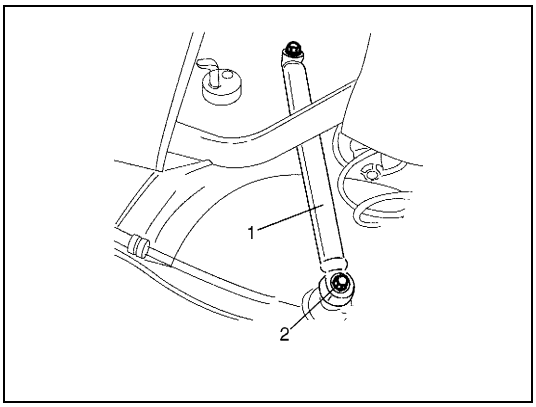


1) Install coil springs (1) (right & left) on spring seat (2) of rear axle as shown in figure and then raise rear axle.

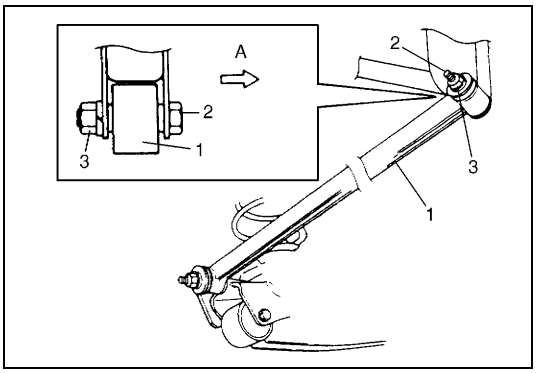
NOTE:

When seating coil spring (1), mate spring end with stepped part (3) of rear axle spring seat as shown.

A :	Upper side
"a":	Small
"b":	Large

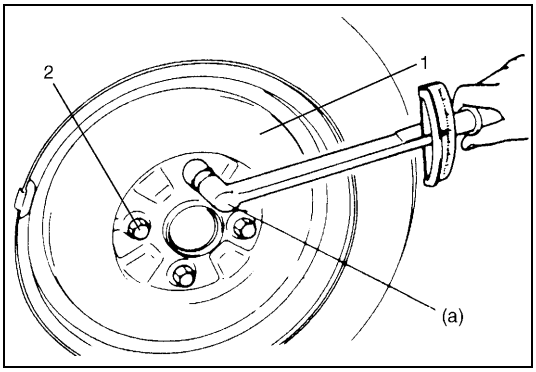


2) Install shock absorber (1) lower side to rear axle.
   Tighten shock absorber lower bolt (2) temporarily at this step.
3) Remove floor jack from rear axle.
4) Install brake flexible hose E-ring.
5) Install LSPV spring to rear axle.
   Tighten LSPV adjust nut temporarily at this step (if equipped with LSPV).



6) Install lateral rod (1) right side to vehicle body, refer to the figure for proper installing direction of bolt (2).
   Tighten nut (3) temporarily at this step.
7) Remove floor jack from rear axle (2WD vehicle) or rear axle housing (4WD vehicle).

A :	Forward



8) Install wheel (1) and tighten wheel nuts (2) to specified torque.

Tightening torque
Wheel nut (a): 85 N·m (8.5 kg-m, 61.5 lb-ft)

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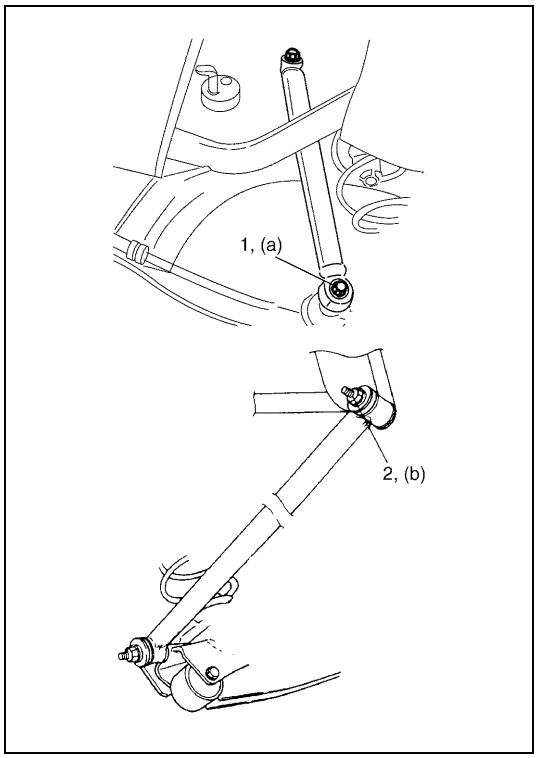


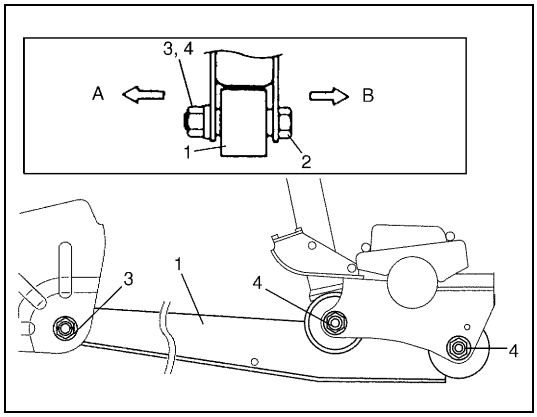
9) Lower hoist and vehicle in non-loaded condition, tighten absorber lower bolt (1) and lateral rod right side nut (2) to specified torque.

Tightening torque
Rear shock absorber lower bolt
(a): 85 N·m (8.5 kg-m, 61.5 lb-ft)
Lateral rod body side nut
(b): 65 N·m (6.5 kg-m, 47.0 lb-ft)

10) If equipped with LSPV, check and adjust LSPV spring referring to “LSPV INSPECTION AND ADJUSTMENT” and perform “FLUID PRESSURE TEST” in Section 5.

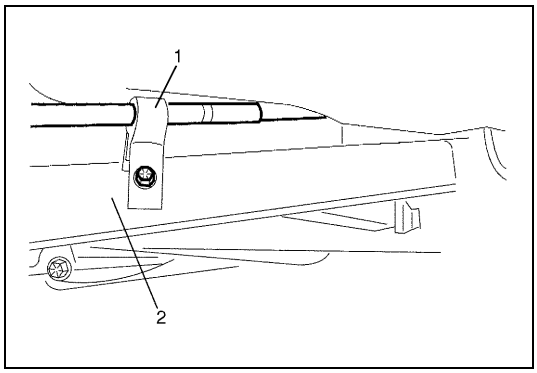
Trailing Arm

Installation



1) Install trailing arm (1) to vehicle body and rear axle, referring to figure for proper installing direction of bolts (2).
Tighten front nut (3) and rear nuts (4) temporarily at this step.

A :	Vehicle out side
B :	Vehicle center side



2) Install parking brake cable clamp (1) to trailing arm (2).
3) Clamp wheel speed sensor lead wire (right & left) to trailing arm securely (if equipped with ABS).

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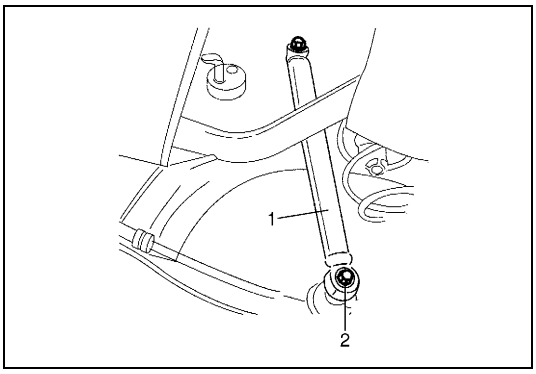
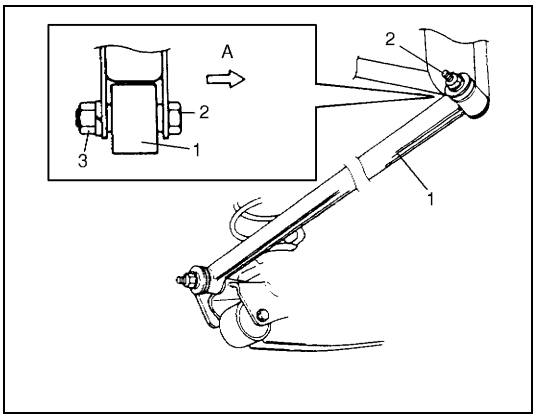


4) Install shock absorber (1) lower side to rear axle.
   Tighten shock absorber lower bolt (2) temporarily at this step.

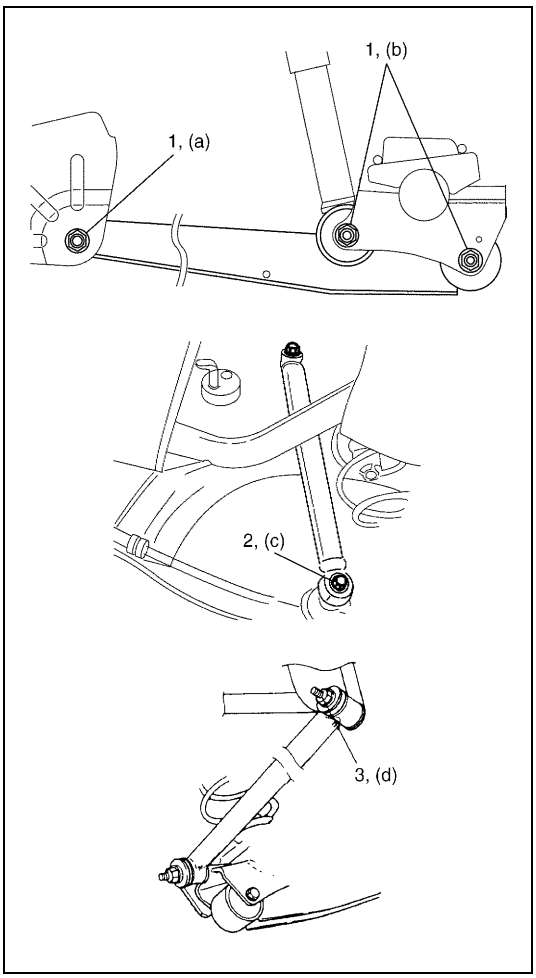


5) Install lateral rod (1) to vehicle body, refer to the figure for proper installing direction of bolt (2).
   Tighten nut (3) temporarily at this step.
6) Remove floor jack from rear axle.
7) Install wheel and tighten wheel nuts to specified torque.

Tightening torque
Wheel nut: 85 N·m (8.5 kg-m, 61.5 lb-ft)

A : Forward

8) Lower hoist.



9) Tighten front and rear trailing arm nuts (1), shock absorber lower bolts (2) and lateral rod right side nut (3) to specified torque (right and left).

NOTE:

When tightening these nuts, be sure that vehicle is off hoist and in no-loaded condition.

Tightening torque
Front trailing arm nut (a): 90 N·m (9.0 kg-m, 65.0 lb-ft)
Rear trailing arm nut (b): 80 N·m (8.0 kg-m, 58.0 lb-ft)
Rear shock absorber lower bolt
(c): 85 N·m (8.5 kg-m, 61.5 lb-ft)
Lateral rod body side nut (d): 65 N·m (6.5 kg-m, 47.0 lb-ft)

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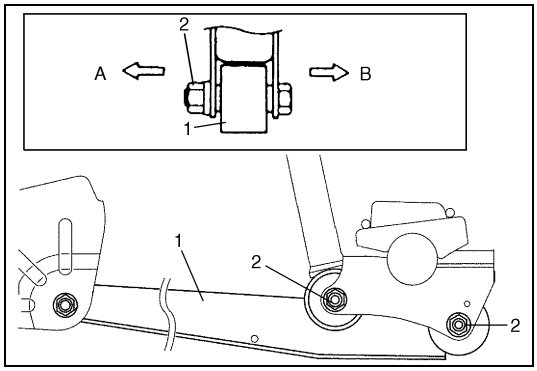
Rear Axle (2WD Except Sport Model)

Installation

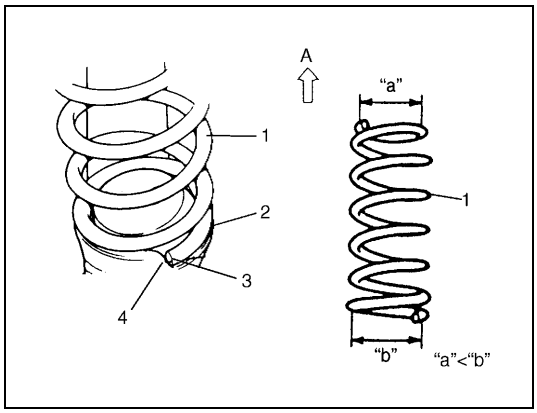
Install removed parts in reverse order of removal, noting the following points.

1) Place rear axle on floor jack.
   Then install lateral rod to rear axle and tighten nut temporarily at this step.



2) Install trailing arms (1) (right & left) to rear axle in proper direction as shown in figure.
   Tighten rear trailing arm nuts (2) temporarily at this step.

A : Vehicle outside
B : Vehicle center side

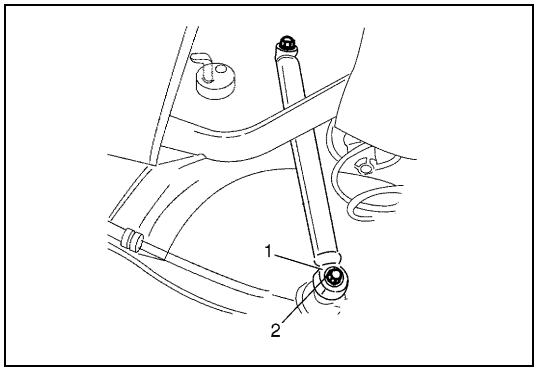


3) Install coil springs (1) (right & left) on spring seat (2) of rear axle and raise rear axle.

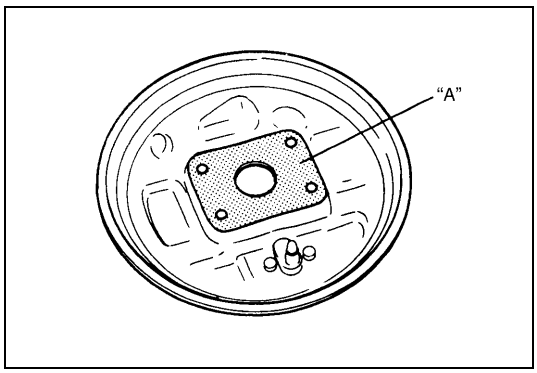
NOTE:

Upper and lower diameters of coil spring are different. Bring larger diameter end at bottom and mate its open end (3) with stepped part (4) of rear axle spring seat as shown.

A : Upper side



4) Install shock absorber (1) lower sides (right & left) to rear axle.
   Tighten shock absorber lower bolts (2) temporarily at this step.
5) Remove floor jack from rear axle.



6) Clean mating surfaces (right and left) of rear axle with brake back plate and apply water tight sealant as shown in figure.

"A": Sealant 99000-31090

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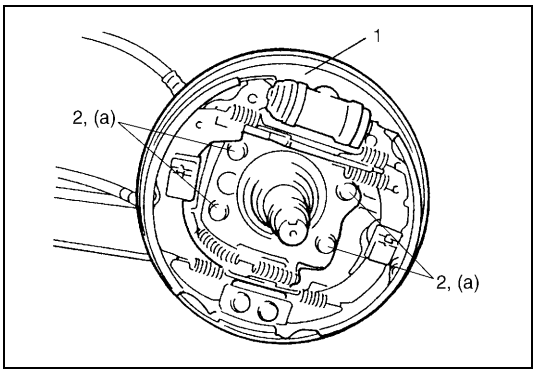
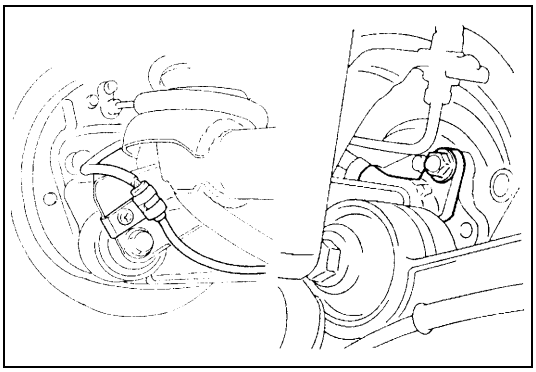
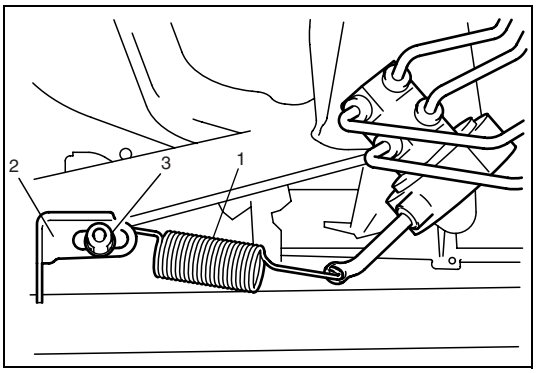


7) Install brake back plates (1) (right and left) and tighten back plate bolts (2) to specified torque.

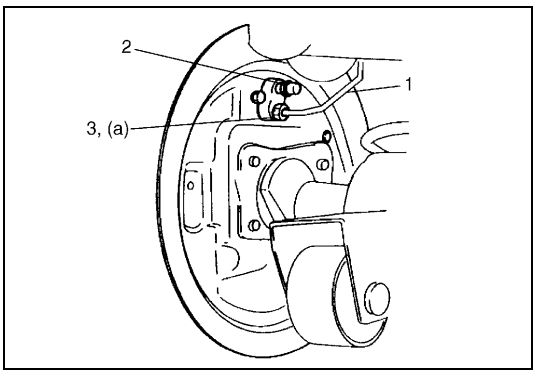
Tightening torque
Brake back plate bolt (a): 23 N·m (2.3 kg-m, 17.0 lb-ft)



8) Install wheel speed sensor and clamp wire securely (right & left) (if equipped with ABS).

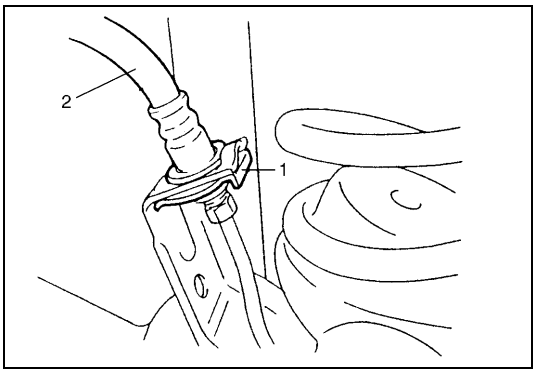


9) Install LSPV spring (1) to rear axle (2).
Tighten nut (3) temporarily at this step (if equipped with LSPV).



10) Connect brake pipes (1) (right & left) to wheel cylinders (2) and tighten brake pipe flare nuts (3) to specified torque.

Tightening torque
Brake pipe flare nut (a): 16 N·m (1.6 kg-m, 11.5 lb-ft)



11) Connect brake flexible hoses (1) to bracket on rear axle and secure it with E-rings (2).
12) Install brake drums (right & left). Refer to “Brake Drum” in Section 5.
13) Fill reservoir with brake fluid and bleed brake system (For bleeding operation, refer to Section 5.)

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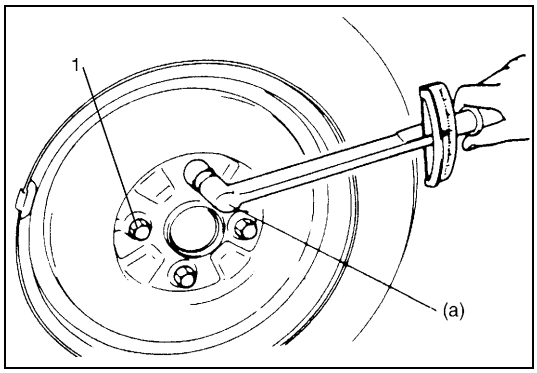
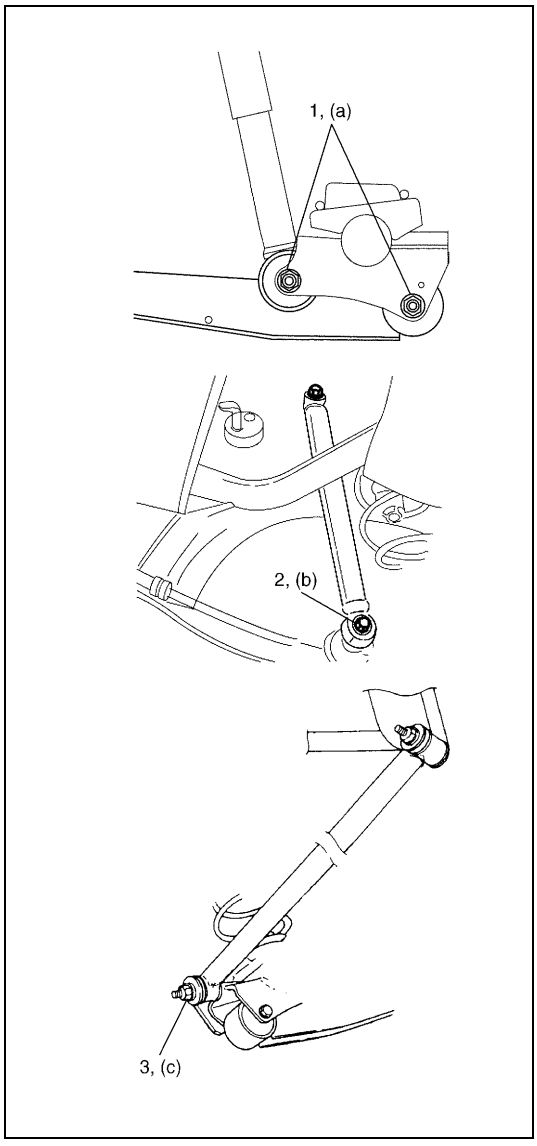


14) Install wheel and tighten wheel nuts (1) to specified torque.

Tightening torque
Wheel nut (a): 85 N·m (8.5 kg-m, 61.5 lb-ft)

15) Upon completion of all jobs, depress brake pedal with about 300 N (30 kg, 66 lbs) load three to five times so as to obtain proper drum-to-shoe clearance.
Adjust parking brake cable. Refer to Section 5.
16) Install console box.
17) Lower hoist and bounce vehicle up and down several times to stabilize suspension.
Be sure that vehicle is off hoist and in non loaded condition.



18) Tighten rear trailing arm nuts (1), shock absorber lower bolts (2) and lateral rod left side nut (3) to specified torque (right and left).

Tightening torque
Rear trailing arm nut (a): 80 N·m (8.0 kg-m, 58.0 lb-ft)
Rear shock absorber lower bolt
(b): 85 N·m (8.5 kg-m, 61.5 lb-ft)
Lateral rod axle housing side nut
(c): 65 N·m (6.5 kg-m, 47.0 lb-ft)

19) Check to ensure that brake drum is free from dragging and proper braking is obtained.
20) If equipped with LSPV, check and adjust LSPV spring referring to “LSPV Inspection and Adjustment” and perform “Fluid Pressure Test” in Section 5.
21) Perform brake operation test (foot brake and parking brake).

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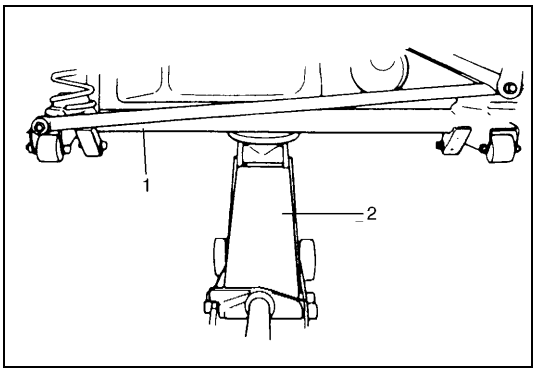
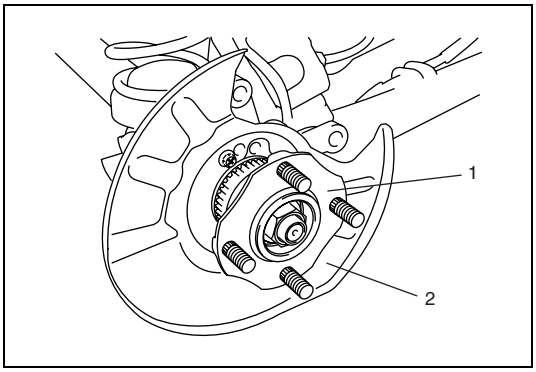
Rear Axle (Sport Model)

Removal

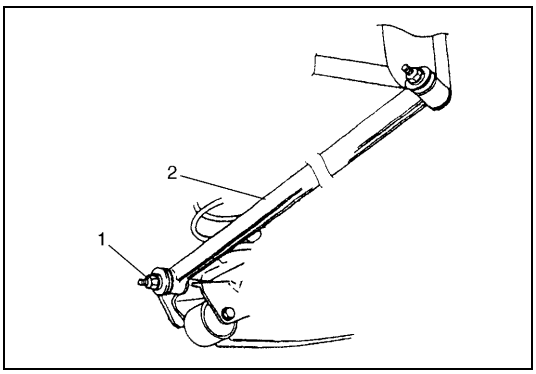
1) Hoist vehicle and remove rear wheels (right & left).



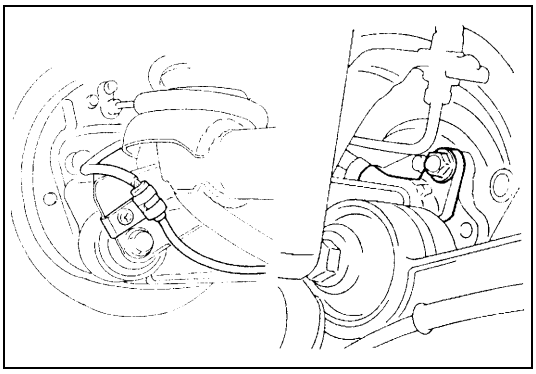
2) Support rear axle (1) using floor jack (2).
3) Remove rear brake caliper assembly and brake disc (right & left) referring to “Rear Brake Disc” in Section 5.



4) Remove rear wheel hub (1) referring to “Rear Wheel Hub And Wheel Stud” in this section.
5) Remove brake disc dust cover (2) (right & left) from rear axle and hang removed back plate with a wire hook.



6) Remove lateral rod left side nut (1).
7) Detach lateral rod (2) left side from rear axle.



8) Remove wheel speed sensor and release clamps (right & left) (if equipped with ABS).

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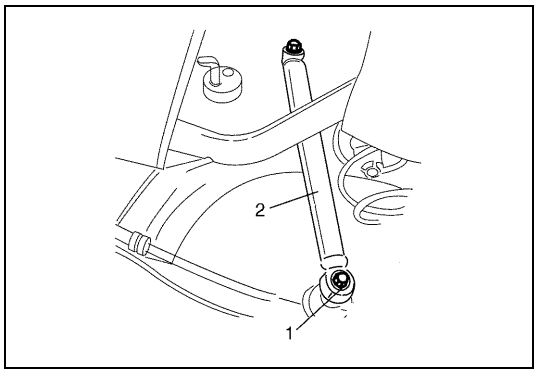
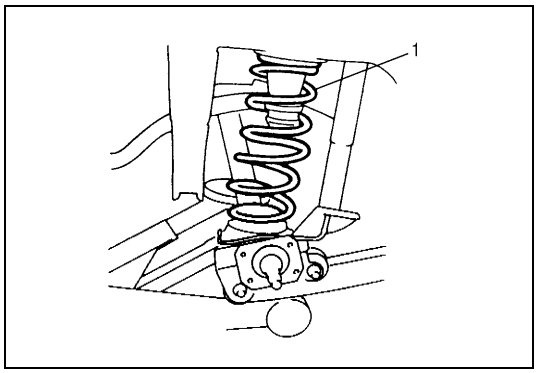
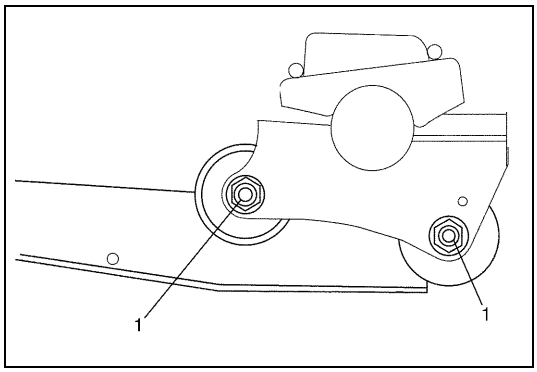


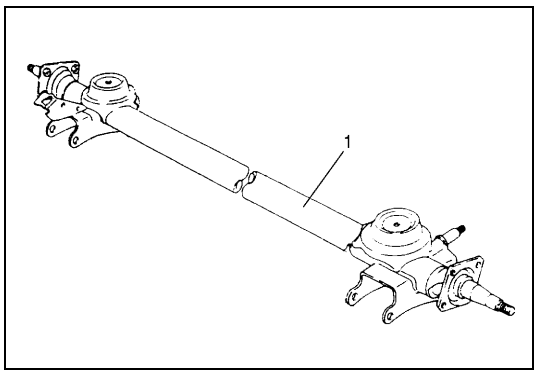
9) Remove shock absorber lower bolts (1) (right & left).
10) Detach shock absorber (2) lower sides (right & left) from rear axle.



11) Lower rear axle gradually as far down as where coil springs (1) (right & left) can be removed.
12) Remove coil springs (1) (right & left).



13) Loosen rear trailing arm nuts (1) from trailing arm but don't remove bolts (right & left).



14) While supporting rear axle (1) at both ends (right & left), remove rear trailing arm bolts (right & left) and then remove rear axle (1) from chassis by lowering floor jack gradually.

Installation

Install removed parts in reverse order of removal, noting the following points.

1) Place rear axle on floor jack.
   Then install lateral rod to rear axle and tighten nut temporarily at this step.

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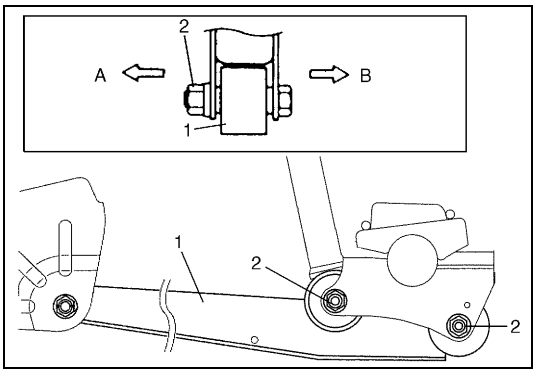
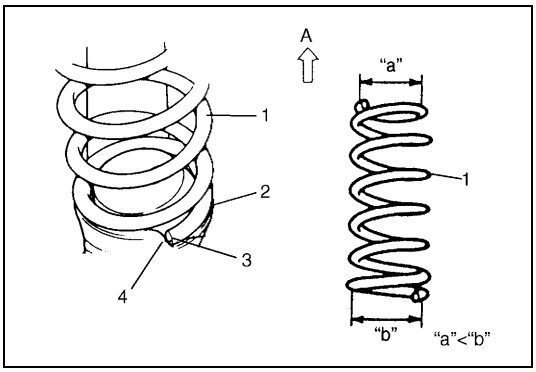


2) Install trailing arms (1) (right & left) to rear axle in proper direction as shown in figure.
   Tighten rear trailing arm nuts (2) temporarily at this step.

A :	Vehicle outside
B :	Vehicle center side

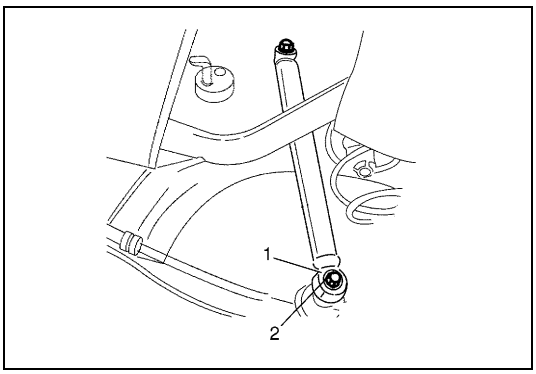


3) Install coil springs (1) (right & left) on spring seat (2) of rear axle and raise rear axle.

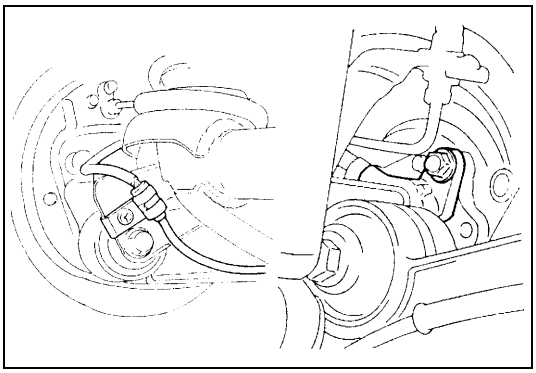
NOTE:

Upper and lower diameters of coil spring are different. Bring larger diameter end at bottom and mate its open end (3) with stepped part (4) of spring seat as shown.

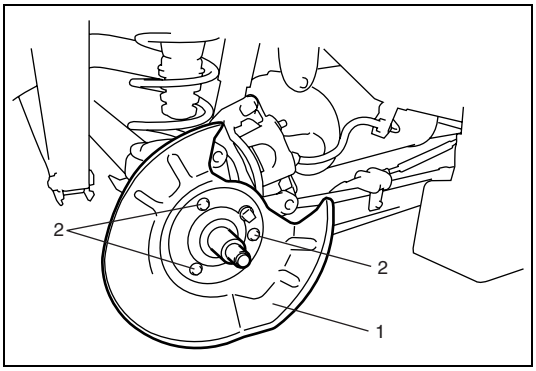
A :	Upper side



4) Install shock absorber (1) lower sides (right & left) to rear axle.
   Tighten shock absorber lower bolts (2) temporarily at this step.
5) Remove floor jack from rear axle.



6) Install wheel speed sensor and clamp wire securely (right & left) (if equipped with ABS).



7) Install brake dust cover (1) (right and left) and tighten brake dust cover bolts (2) to specified torque.

Tightening torque
Brake back plate bolt (a): 11 N·m (1.1 kg-m, 8.0 lb-ft)

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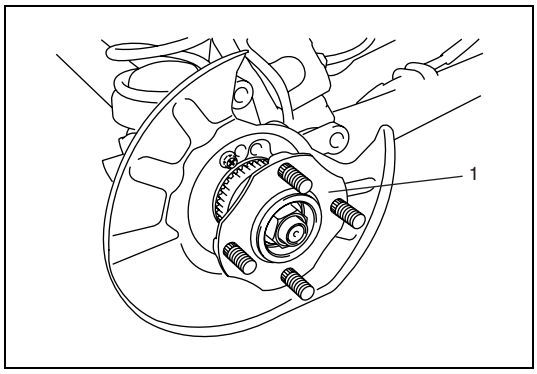
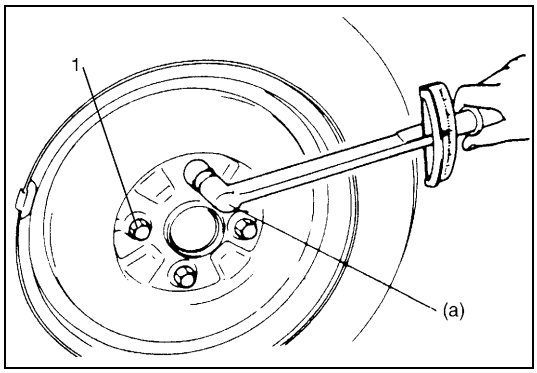


8) Install rear wheel hub (1) referring to “Rear Wheel Hub and Wheel Stud” in this section.
9) Install rear brake caliper assembly and brake disc referring to “Rear Brake Disc” in Section 5.



10) Install wheel and tighten wheel nuts (1) to specified torque.

Tightening torque
Wheel nut (a): 85 N·m (8.5 kg-m, 61.5 lb-ft)

11) Upon completion of all jobs, depress brake pedal with about 300 N (30 kg, 66 lbs) load three to five times so as to obtain proper pad-to-disc clearance.
    Adjust parking brake cable. Refer to Section 5.
12) Install console box.
13) Lower hoist and bounce vehicle up and down several times to stabilize suspension.
    Be sure that vehicle is off hoist and in non loaded condition.

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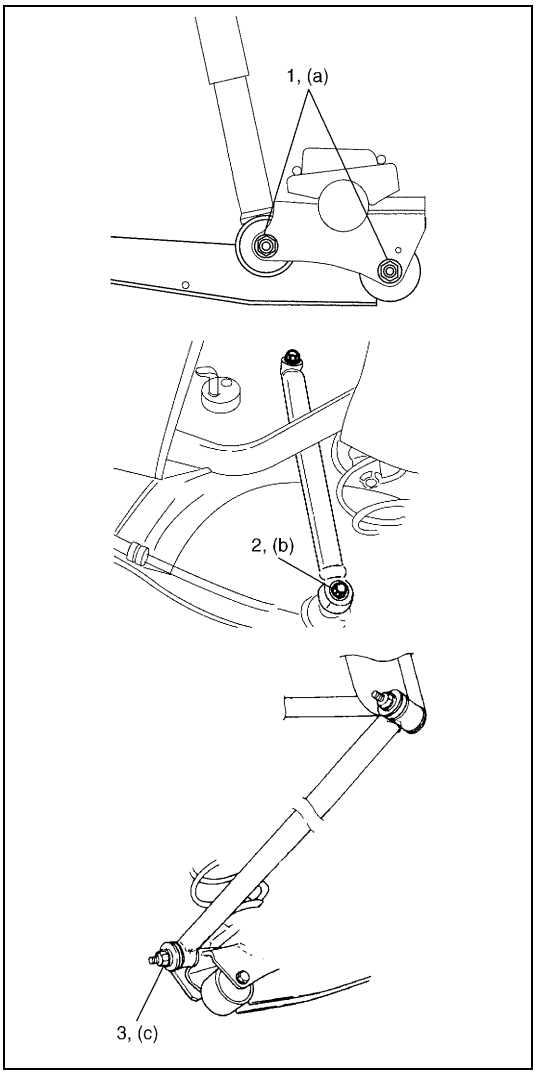


14) Tighten rear trailing arm nuts (1), shock absorber lower bolts (2) and lateral rod left side nut (3) to specified torque (right and left).

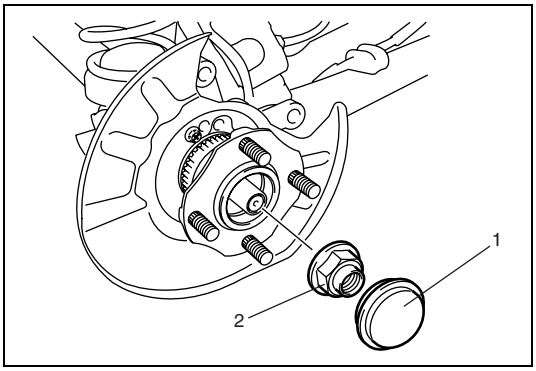
Tightening torque
Rear trailing arm nut (a): 80 N·m (8.0 kg-m, 58.0 lb-ft)
Rear shock absorber lower bolt
(b): 85 N·m (8.5 kg-m, 61.5 lb-ft)
Lateral rod axle housing side nut
(c): 65 N·m (6.5 kg-m, 47.0 lb-ft)

15) Check to ensure that brake drum is free from dragging and proper braking is obtained.
16) If equipped with LSPV, check and adjust LSPV spring referring to “LSPV Inspection and Adjustment” and perform “Fluid Pressure Test” in Section 5.
17) Perform brake operation test (foot brake and parking brake).

Rear Wheel Hub and Wheel Stud (Sport Model)

Removal

1) Hoist vehicle and remove wheel.
2) Remove rear brake disc and caliper referring to “Rear Brake Disc” in Section 5.



3) Remove spindle cap (1) by hammering lightly at 3 locations around it so as not to deform or cause damage to seating part of cap.
4) Unstake and remove rear axle nut (2).

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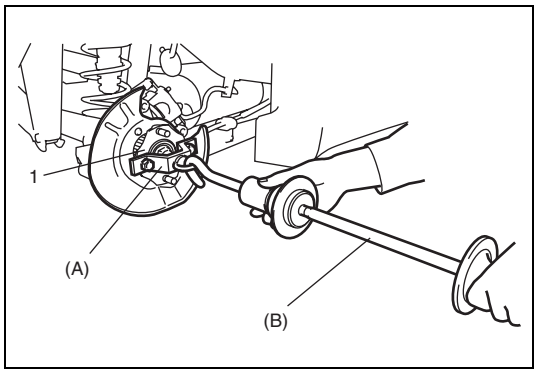
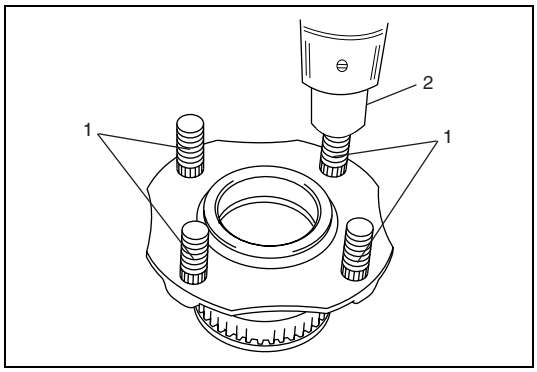


5) Using special tools, draw out wheel hub (1).

Special tool
(A): 09943-17912
(B): 09942-15511

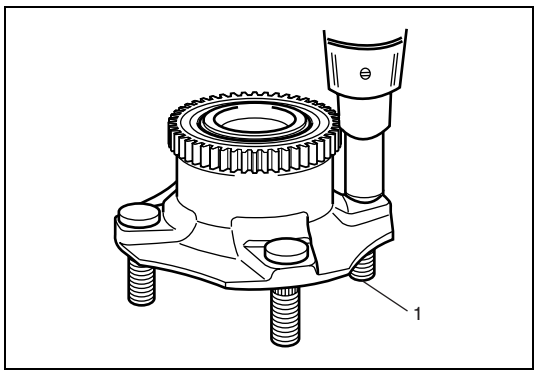


6) Remove hub bolts (1) with hydraulic press (2) or copper hammer.

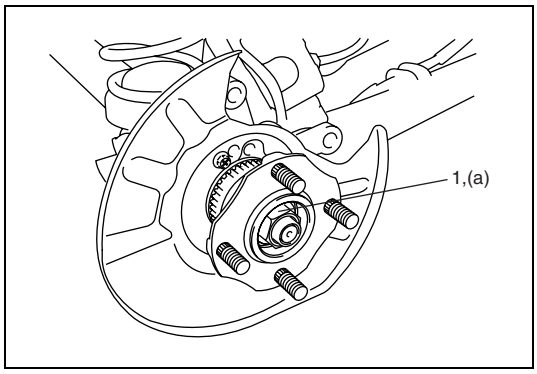
CAUTION:
Never remove the hub bolts (1) unless replacement is necessary. Be sure to use new bolts for replacement.

Installation

Install wheel hub and wheel stud by reversing removal procedure noting the following instructions.



- Insert new stud bolt (1) in the hub hole. Rotate stud bolt slowly to ensure that serrations are aligned with those made by original bolt.



- Install new rear axle nut (1) and tighten to specified torque.

CAUTION:
Never reuse rear axle nut.

Tightening torque
Rear axle nut (a): 175 N·m (17.5 kg-m, 130 lb-ft)

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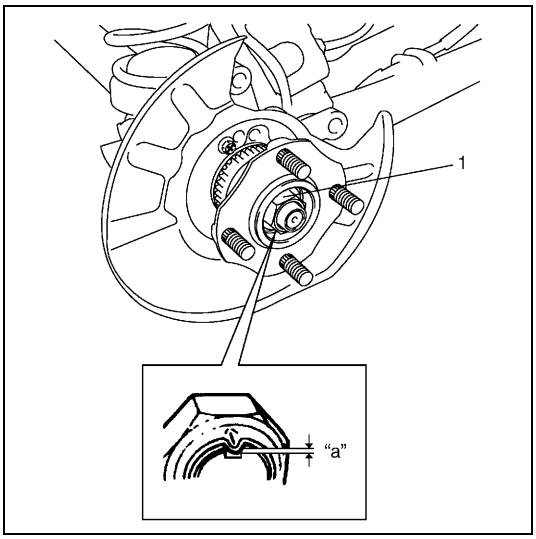


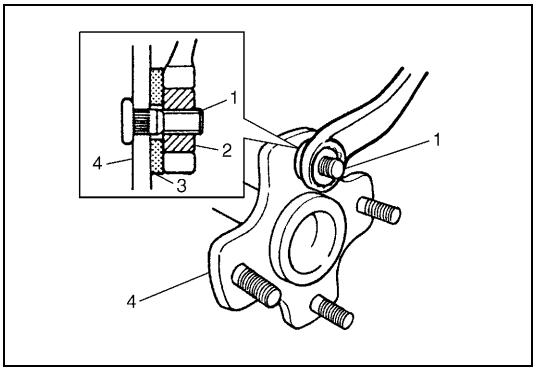
- Stake rear axle nut (1) as shown.

CAUTION:
Take care while staking nut. If a split occurs in staked area of nut, replace it with new one.

Stake specification
"a": 0.5 mm (0.02 in.) or more

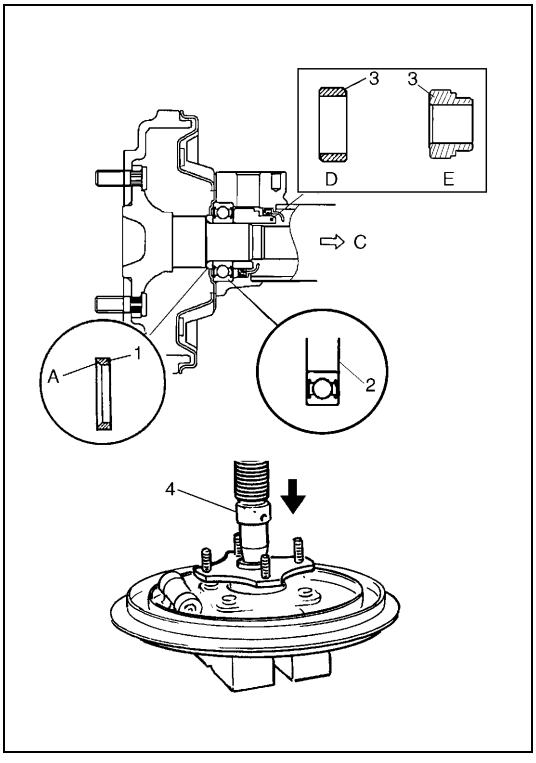
Rear Axle Shaft and Wheel Bearing (4WD Vehicle)

Installation



1) Aligning serrations between new stud bolts (1) and flange (4), install new stud bolts by tightening nut as shown.

2.	Nut
3.	Washer



2) Press in a new bearing (2) and retainer ring (3) in order by using an hydraulic press (4).

NOTE:
- **Install wheel bearing spacer (1) with the tapered side of its inner diameter directed toward outside, or brake drum side.**
- **Use care not to cause any damage to outside of retainer ring.**

3) Install wheel sensor ring (if equipped with ABS).
Refer to "Rear Wheel Sensor Ring" of Section 5E.

A :	Tapered side
B :	Blank
C :	Differential side
D :	Without ABS
E :	With ABS

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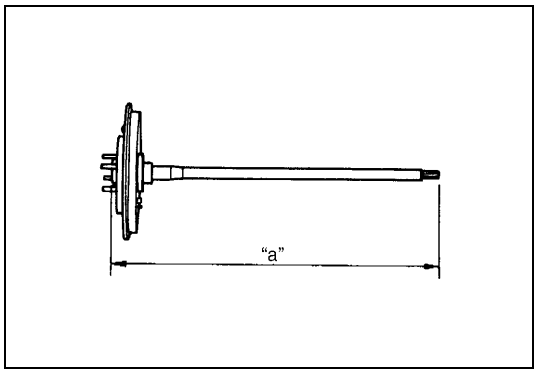
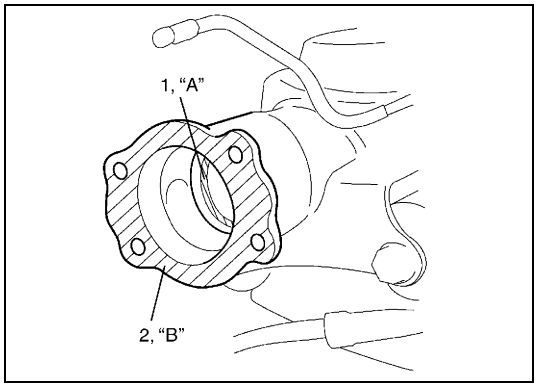


4) Inspect axle shaft length.

Rear axle shaft length "a"
Right side: 657.5 mm (25.9 in.)
Left side: 785.5 mm (30.9 in.)

5) Install rear axle shaft oil seal referring to "Rear Axle Shaft Oil Seal (4WD Vehicle)" in this section.



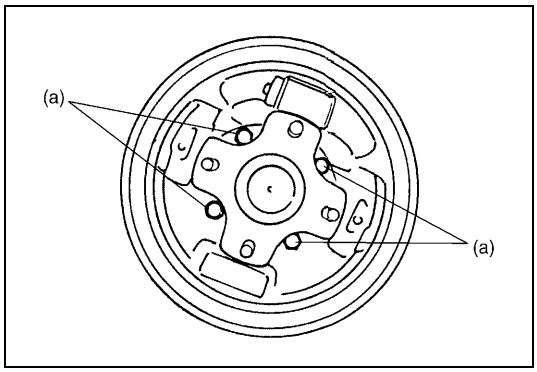
6) Apply grease to axle shaft oil seal (1) lip as shown.

"A": Grease 99000-25010

7) Apply sealant to mating surface of axle housing (2) with brake back plate.

NOTE:
Make sure to remove old sealant before applying it anew.

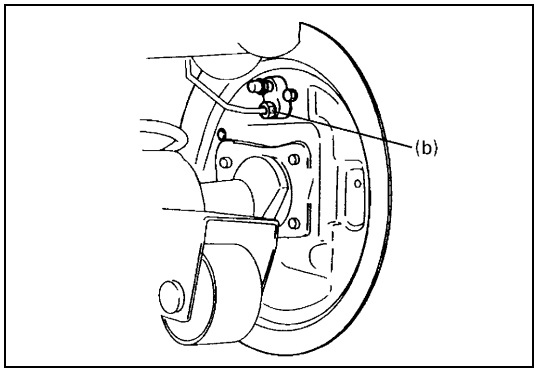
"B": Sealant 99000-31090



8) Install rear axle shaft to rear axle housing and tighten brake back plate bolts to specified torque.

NOTE:
When installing rear axle shaft, be careful not to cause damage to oil seal lip in axle housing.

Tightening torque
Brake back plate bolt (a): 23 N·m (2.3 kg-m, 17.0 lb-ft)



9) Connect brake pipe to wheel cylinder and tighten brake pipe flare nut to specified torque.

Tightening torque
Brake pipe flare nut (b): 16 N·m (1.6 kg-m, 11.5 lb-ft)

10) Refill rear axle (differential) housing with new specified gear oil. Refer to Section 7F for refill.
11) Install brake drum. For details, refer to "Brake Drum" of Section 5.

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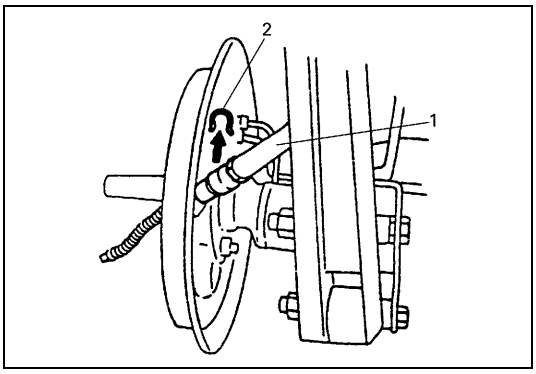
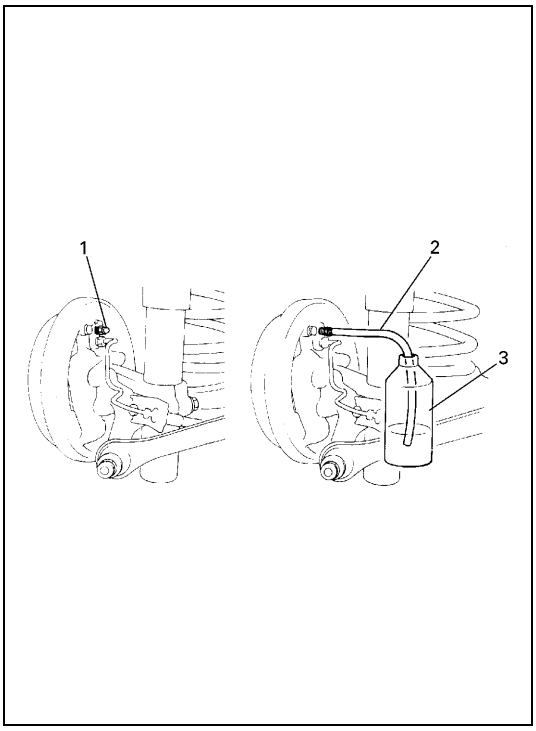


12) Connect parking brake cable (1) to parking brake shoe lever. Secure parking brake cable to brake back plate with clip (2). Install wheel speed sensor (if equipped with ABS).

CAUTION:
Check to ensure that clip is in good condition before installing it. If deformed or broken, replace.



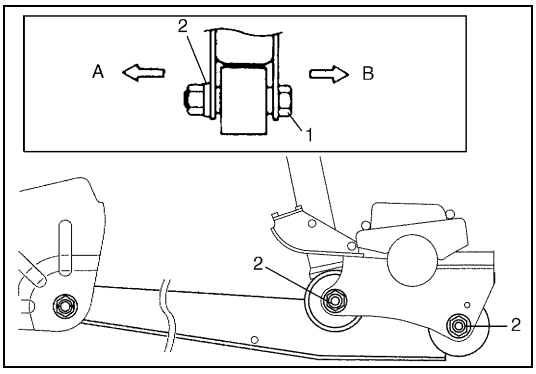
13) Fill reservoir with brake fluid and bleed brake system. (For bleeding operation, refer to “Bleeding Brakes” in Section 5.)
14) Install wheel and tighten wheel nuts to specified torque.
15) Upon completion of all jobs, pull parking brake lever with about 20 kg, (44 lbs) load three to five times so as to obtain proper drum-to-shoe clearance.
    Adjust parking brake cable (for adjustment, refer to “Parking Brake Inspection and Adjustment” in Section 5).
16) Check to ensure that brake drum is free from dragging and proper braking is obtained.
17) Perform brake test (foot brake and parking brake).
    (For brake test, see Section 5.)
18) Check each installed part for oil leakage.

1.	Plug cap
2.	Vinyl tube (See-through tube)
3.	Container

Rear Axle Housing (4WD Vehicle)

Installation

Install removed parts in reverse order of removal, noting the following.



1) Place rear axle housing on floor jack. Then install rear trailing arm bolts (1) (right & left) in proper direction as shown. At this time, mount nuts (2) but don’t tighten them.

A :	Vehicle out side
B :	Vehicle center side

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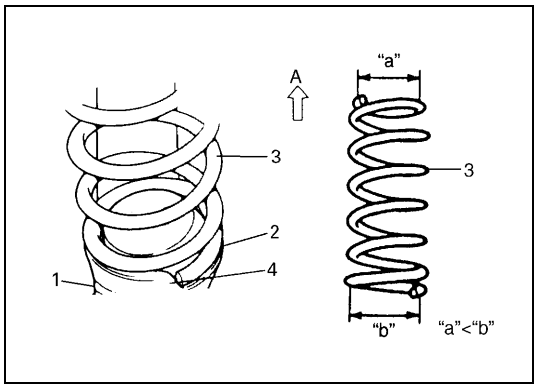
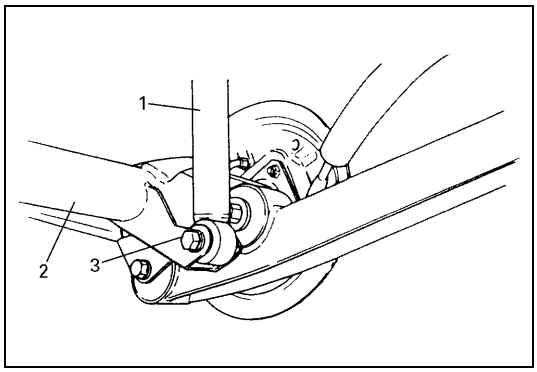


2) Install coil springs (3) (right & left) on spring seat (2) of axle housing (1) and raise axle housing.

NOTE:

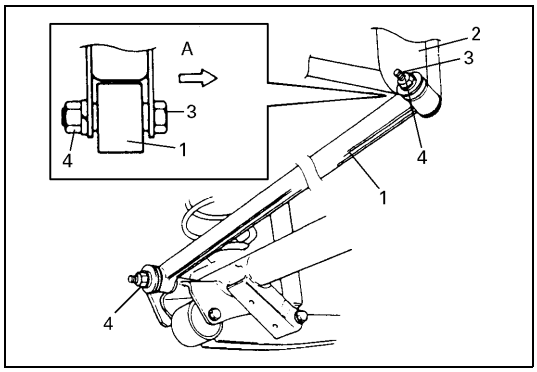
Upper and lower diameters of coil spring are different. Bring lager diameter end at bottom and set its open end in place on spring seat.

4. Stopped part
A : Upper side



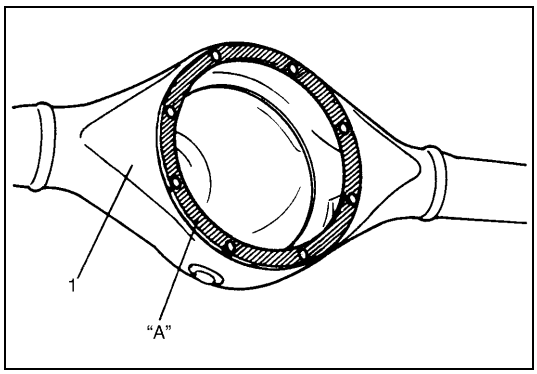
3) Install lower part of shock absorber (1) to right and left sides of axle housing and install bolts in proper direction as shown. At this time, mount bolts (3) (right & left) but don't tighten them.

2. Rear axle housing



4) Install lateral rod (1) and install bolt (3) in proper direction as shown. At this time, mount bolt and nut (4) but don't tighten them.

2. Vehicle body
A : Forward

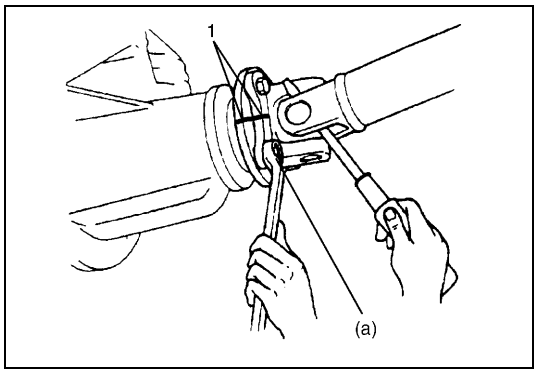


5) Clean mating surfaces of axle housing (1) and differential carrier and apply sealant to housing side.

"A": Sealant 99000-31110

6) Install differential carrier assembly to axle housing and tighten carrier nuts to specified torque.

Tightening torque
Rear differential carrier nut: 23 N·m (2.3 kg-m, 17.0 lb-ft)



7) Install propeller shaft to joint flange aligning match marks (1) and tighten flange bolts to specified torque.

Tightening torque
Companion flange bolt (a): 23 N·m (2.3 kg-m, 17.0 lb-ft)

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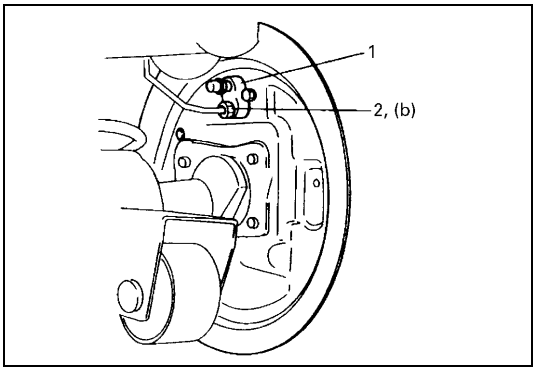
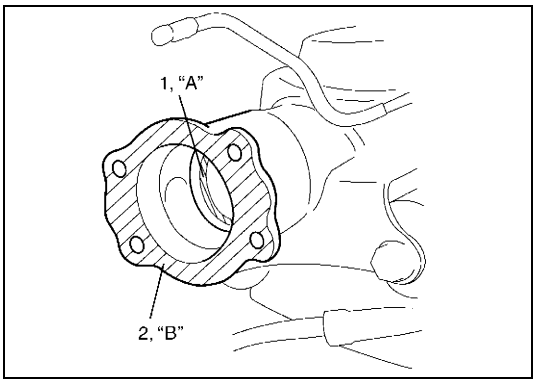
8) Install LSPV spring to rear axle.
   Tighten LSPV adjust nut temporarily at this step. (if equipped with LSPV).
9) Install wheel speed sensor and clamp wire securely (right & left) (if equipped with ABS).
10) Remove floor jack from axle housing.
11) Connect brake pipes and parking brake cable and clamp them securely.
    For clamping positions, refer to Section 5.
12) Connect brake flexible hose to bracket and secure it with E-ring.



13) Connect brake pipe to wheel cylinder (1) (right and left) and tighten brake pipe flare nuts (2) to specified torque.

Tightening torque
Brake pipe flare nut (b): 16 N·m (1.6 kg-m, 11.5 lb-ft)

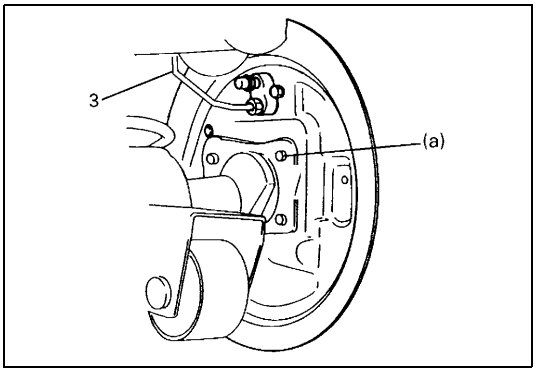


14) Clean mating surface of axle housing (2) (right & left) with brake back plate and apply sealant as shown.

"B": Sealant 99000-31090

15) Apply grease to axle shaft oil seals (1) lip (right & left) as shown.

"A": Grease 99000-25010



16) Install rear axle shaft (right & left) to rear axle housing and tighten brake back plate bolts to specified torque.

Tightening torque
Brake back plate bolt (a): 23 N·m (2.3 kg-m, 17.0 lb-ft)

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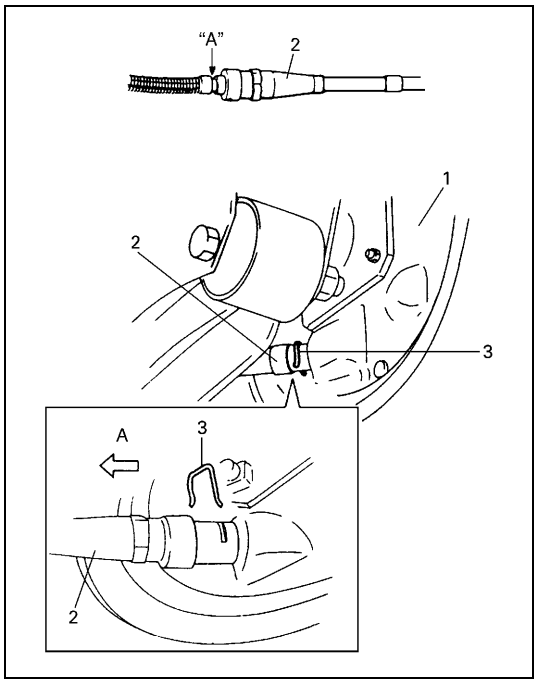


17) Connect parking brake cable (2) to parking brake shoe lever (right & left) and secure it with clip (3).
Apply water tight sealant where brake back plate (1) and parking brake cable contact.

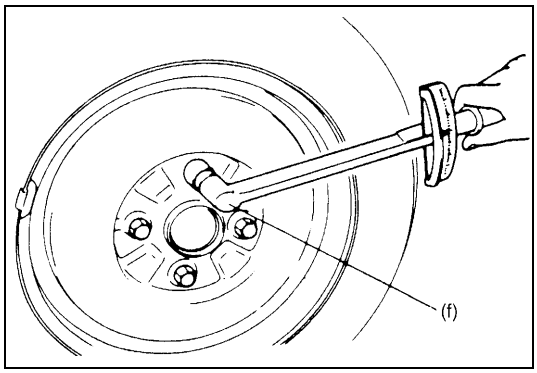
"A": Sealant 99000-31090

NOTE:

Check to ensure that clip is in good condition before installing it. If deformed or broken, replace.

18) Fill reservoir with brake fluid and bleed brake system. (For bleeding operation, see Section 5.)
19) Refill differential gear housing with new specified gear oil. Refer to Section 7F.

A : Forward



20) Install wheel and tighten wheel nuts to specified torque.

Tightening torque
Wheel nut (f): 85 N·m (8.5 kg-m, 61.5 lb-ft)

21) Upon completion of all jobs, pull parking brake lever with about 20 kg, (44 lbs) load three to five times so as to obtain proper drum-to-shoe clearance.
Adjust parking brake cable (for adjustment, see Section 5.)
22) Lower hoist.

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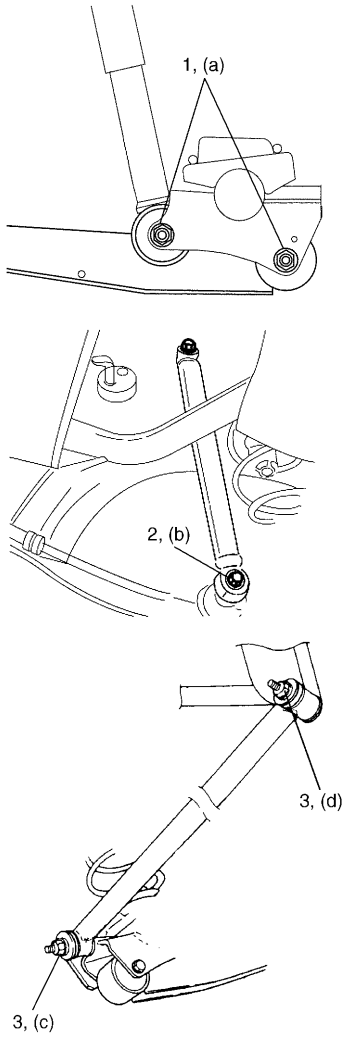

23) Tighten right and left trailing arm bolts and nuts (1) and shock absorber lower bolts (2) to specified torque.
Tighten lateral rod bolt and nut (3) to specified torque.

NOTE:

When tightening these bolts and nuts, be sure that vehicle is off hoist and in non loaded condition.

Tightening torque
Rear trailing arm nut (a): 80 N·m (8.0 kg-m, 58.0 lb-ft)
Rear shock absorber lower bolt
(b): 85 N·m (8.5 kg-m, 61.5 lb-ft)
Lateral rod axle housing side nut
(c): 65 N·m (6.5 kg-m, 47.0 lb-ft)
Lateral rod body side nut (d): 65 N·m (6.5 kg-m, 47.0 lb-ft)

24) Check to ensure that brake drum is free from dragging and proper braking is obtained.
25) Perform brake test (foot brake and parking brake).
(For brake test, see Section 5.)
26) If equipped with LSPV, check and adjust LSPV spring referring to “LSPV Inspection and Adjustment” and perform “Fluid Pressure Test” in Section 5.
27) Check each installed part for oil leakage.

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Tightening Torque Specifications

Fastening part	Tightening torque		
	N•m	kg-m	lb-ft
Brake back plate bolt (Except sport model)	23	2.3	17.0
Brake back plate bolt (Sport model)	11	1.1	8.0
Brake pipe flare nut	16	1.6	11.5
Companion flange bolt	23	2.3	17.0
Front trailing arm nut	90	9.0	65.0
Lateral rod axle housing side nut	65	6.5	47.0
Lateral rod body side nut	65	6.5	47.0
Rear axle nut (4WD model)	175	17.5	130
Rear differential carrier nut	23	2.3	17.0
Rear shock absorber lower bolt	85	8.5	61.5
Rear shock absorber upper nut	85	8.5	61.5
Rear trailing arm nut	80	8.0	58.0
Wheel nut	85	8.5	61.5

Required Service Material

Material	Recommended SUZUKI product (Part Number)	Use
Lithium grease	SUZUKI SUPER GREASE (A) (99000-25010)	• Axle shaft oil seal • Wheel bearing
Sealant	SUZUKI BOND NO. 1215 (99000-31110)	• Joint seam of differential carrier and axle housing
Gear oil	For gear oil information, refer to Section 7F.	• Differential gear (Rear axle housing)
Water tight sealant	SUZUKI SEALING COMPOUND 366E (99000-31090)	• Joint seam of rear axle (or axle housing) and brake back plate

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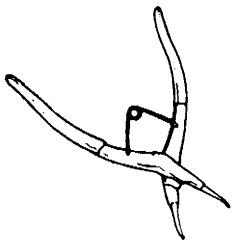
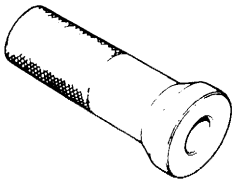
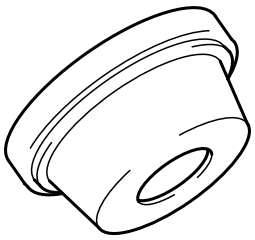
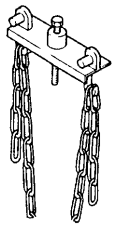
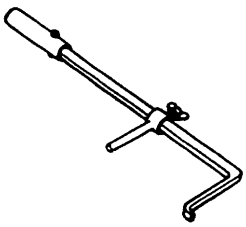
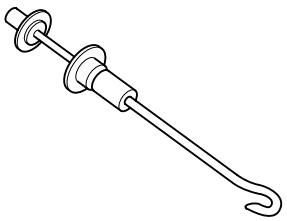
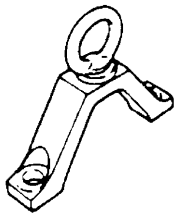
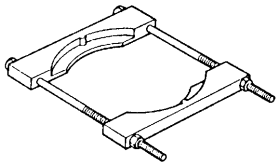
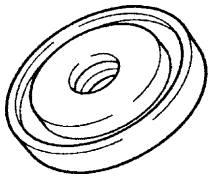
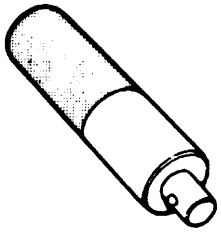
Special Tool

 09900-06108 Snap ring pliers ··· 2WD (Except sport model)	 09913-76010 Rear wheel bearing installer ··· 2WD (Except sport model)	 09924-84510-004 Bearing installer attachment ··· 2WD (Except sport model)	 09927-18411 Universal puller ··· 4WD
 09913-50121 Oil seal remover ··· 4WD	 09942-15511 Sliding hammer ··· 4WD	 09943-17912 Brake drum remover ··· 4WD	 09921-57810 Bearing remover ··· 4WD
 09944-67010 Oil seal installer ··· 4WD	 09924-74510 Bearing installer handle ··· 4WD		

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SECTION 3F

WHEELS AND TIRES

NOTE:

- **All wheel fasteners are important attaching parts in that they could affect the performance of vital parts and systems, and/or could result in major repair expense. They must be replaced with one of the same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of all parts.**
  There is to be no welding as it may result in extensive damage and weakening of the metal.
- **For the items with asterisk (*) in the "CONTENTS" below, refer to the same section of the Service Manual mentioned in "FOREWORD" of this manual.**

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General Description

Tires

This vehicle is equipped with the following tires.

Tire size:

- **165/70R14 81S ····· Except sport model**
- **185/55R15 81V ····· Sport model**

The tire is of tubeless type. The tire is designed to operate satisfactorily with loads up to the full rated load capacity when inflated to the recommended inflation pressures.
Correct tire pressures and driving habits have an important influence on tire life. Heavy cornering, excessively rapid acceleration, and/or unnecessary sharp braking increase tire wear.

Wheels

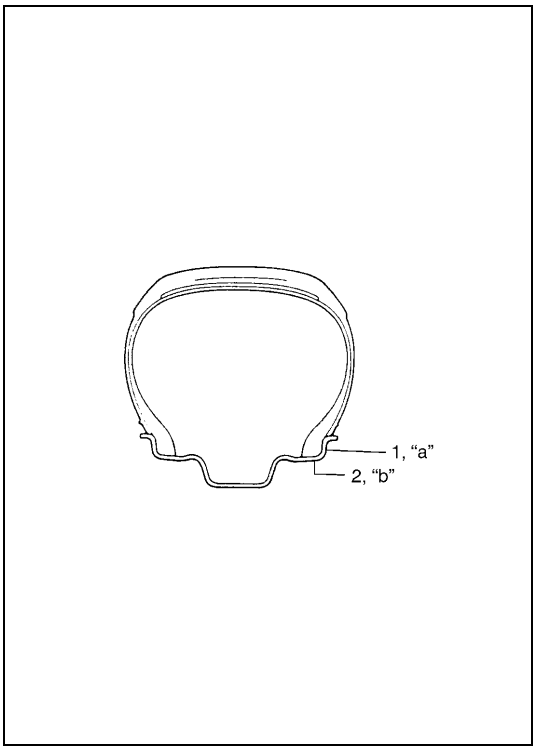
Standard equipment wheels are the following wheels.

Wheel size:

- **14 x 4 1/2 J ····· Except sport model**
- **15 x 5J ····· Sport model**

Replacement Wheels

How to measure wheel runout



To measure the wheel runout, it is necessary to use an accurate dial indicator. The tire may be on or off the wheel. The wheel should be installed to the wheel balancer of the like for proper measurement.
Take measurements of both lateral runout (1) and radial runout (2) at both inside and outside of the rim flange. With the dial indicator set in place securely, turn the wheel one full revolution slowly and record every reading of the indicator.
When the measured runout exceeds the specification and correction by the balancer adjustment is impossible, replace the wheel. If the reading is affected by welding, paint or scratch, it should be ignored.

Wheel lateral runout limit “a”: 0.90 mm (0.035 in.)
Wheel radial runout limit “b”: 0.70 mm (0.028 in.)

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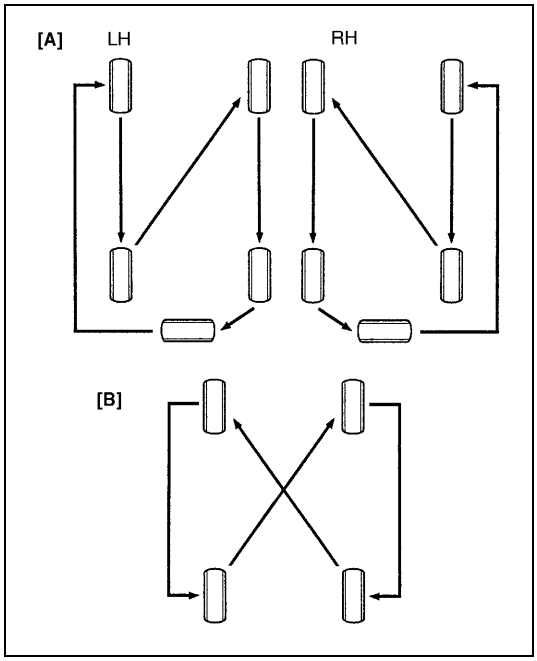
Maintenance and Minor Adjustments

Tire Maintenance

Tire rotation (except sport model)



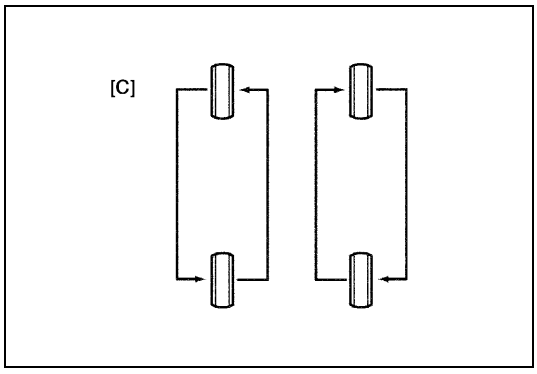
To equalize wear, rotate tires according to left figure. Radial tires should be rotated periodically. Set tire pressure.

NOTE:

Due to their design, radial tires tend to wear faster in the shoulder area, particularly in front positions. This makes regular rotation especially necessary.

[A] : 5-tire rotation
[B] : 4-tire rotation
LH : Left-hand drive
RH : Right-hand drive

Tire rotation (sport model)

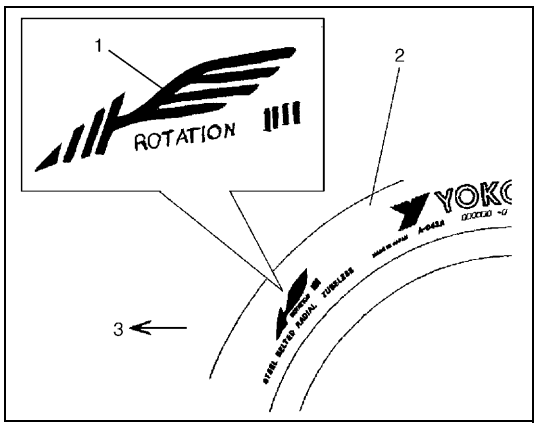


To equalize wear, rotate tires according to left figure. Radial tires should be rotated periodically. Set tire pressure.

NOTE:

Due to their design, radial tires tend to wear faster in the shoulder area, particularly in front positions. This makes regular rotation especially necessary.

[C]: 4-tire rotation



This model uses tires with specified rotation direction which is indicated by a rotation mark (1) on the side of each tire.
When installing tires, mark sure that this rotation mark (1) is directed in the vehicle forward direction.

2. Left side tire
3. Forward

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SECTION 4A

FRONT DRIVE SHAFT

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General Description

A constant velocity double offset joint (DOJ) or tripod joint is used on the differential side of drive shaft as the following table.
A constant velocity ball joint (fixed type) is used on the wheel side of both right and left drive shaft assemblies. The drive shaft can slide through the tripod joint or DOJ in the extension / contraction direction.

Type				Differential side joint	Wheel side joint
M13 engine	2WD	A/T	–	DOJ	Constant velocity ball joint (Fixed type)
		M/T	Right side	Tripod joint	
			Left side	DOJ	
	4WD	A/T	–	DOJ	
		M/T	–	DOJ	
M15 engine	2WD	M/T	–	DOJ	

Diagnosis

Diagnosis Table

Condition	Possible Cause	Correction
Abnormal Noise	• Worn or breakage drive shaft joint	Replace.
	• Worn or breakage center bearing	Replace.

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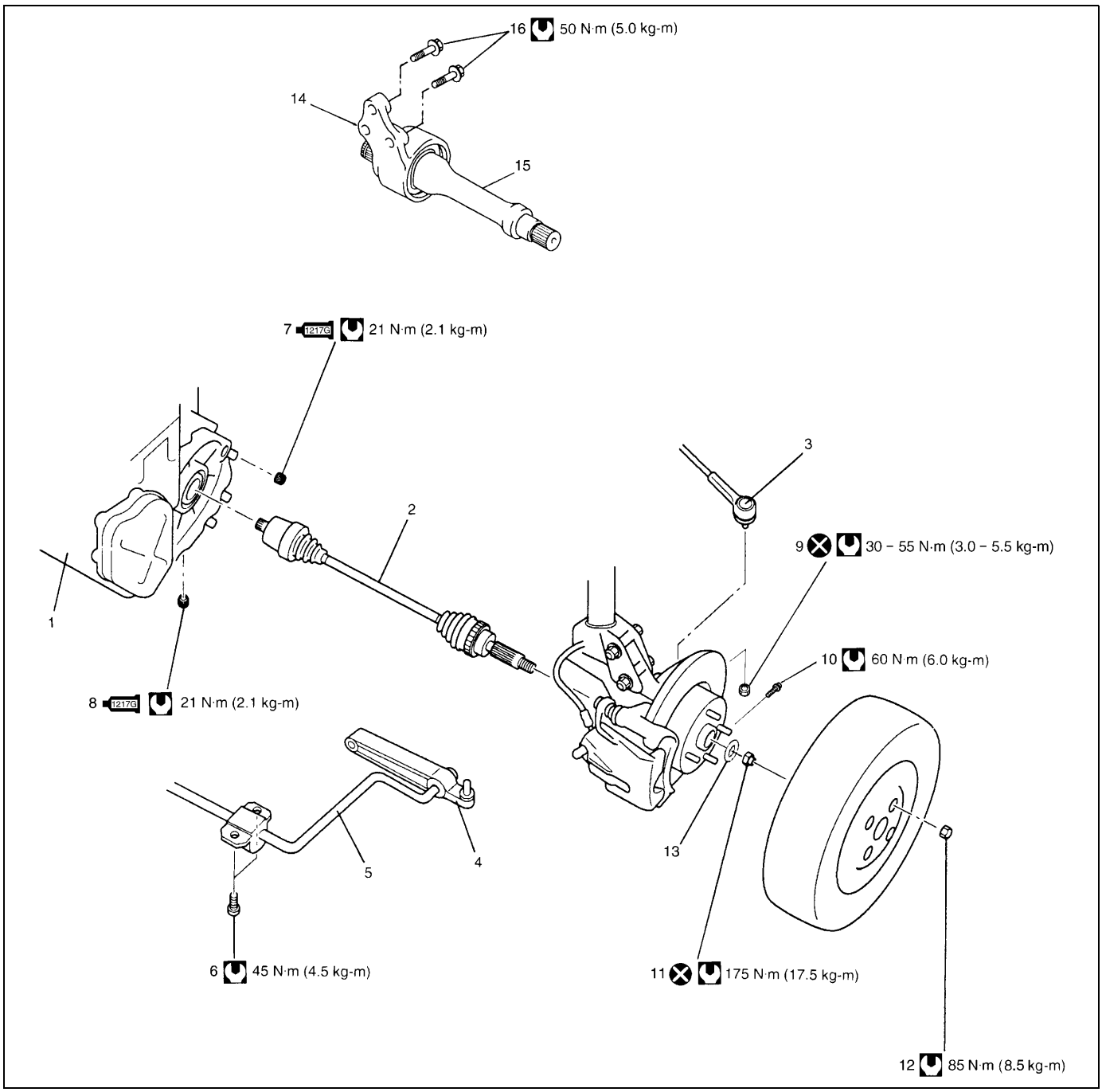
On-Vehicle Service

Front Drive Shaft Assembly Construction



1. Transaxle	7. Oil filler/level plug : Apply sealant 99000-31260 to plug thread	13. Drive shaft washer
2. Drive shaft assembly	8. Oil drain plug : Apply sealant 99000-31260 to plug thread	14. Center bearing support
3. Tie-rod end	9. Tie-rod end castle nut	15. Center shaft
4. Suspension control arm	10. Ball stud bolt	16. Center bearing support bolts
5. Stabilizer	11. Drive shaft nut	Do not reuse.
6. Stabilizer mount bracket bolt	12. Wheel nut	Tightening torque

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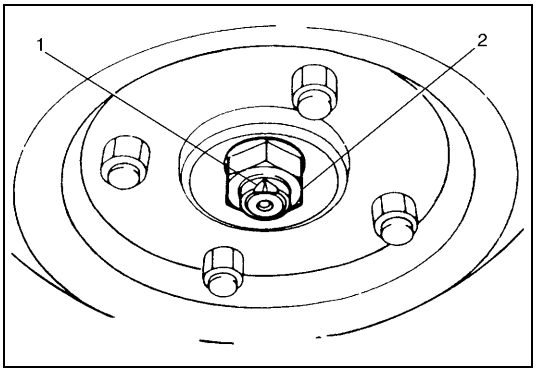
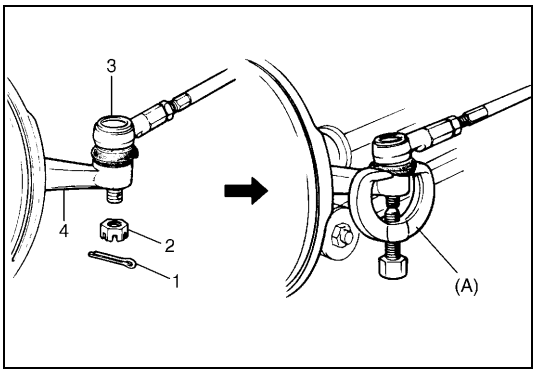
Front Drive Shaft Assembly Removal and Installation

Removal

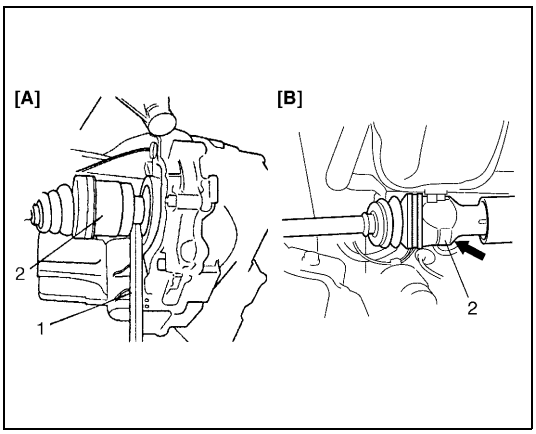


1) Undo caulking (1) and remove drive shaft nut (2) and washer.
2) Hoist vehicle.
3) Remove wheel.
4) Drain transaxle oil referring to “Oil Change” in Section 7A or “Manual Transaxle Oil Change” in Section 7A1.
5) Drain transfer oil (4WD model) referring to “Oil Change” in Section 7D.



6) Remove tie rod end split pin (1) and castle nut (2).
7) Disconnect tie rod end (3) from steering knuckle (4) by using special tool.

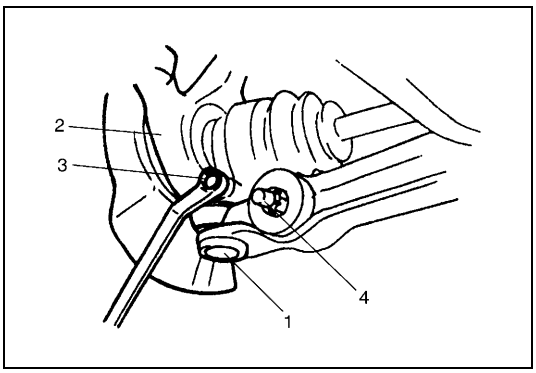
Special tool
(A): 09913-65210



8) Pull out drive shaft joint (2) as follows.
- For vehicle without center shaft or 4WD model
  Using tire lever (1), pull out drive shaft joint (2) so as to release snap ring fitting of joint spline at differential side.
- For vehicle with center shaft or 4WD model
  Using plastic hammer, drive out drive shaft joint (2) so as to release snap ring fitting of joint spline at center shaft or intermediate shaft of transfer.

[A]: For vehicle without center shaft or 4WD model
[B]: For vehicle with center shaft or 4WD model

9) Remove two stabilizer mount brackets from vehicle body.



10) Disconnect front suspension control arm ball stud (1) from steering knuckle (2) by pushing down stabilizer bar (4) after removing ball stud bolt (3).

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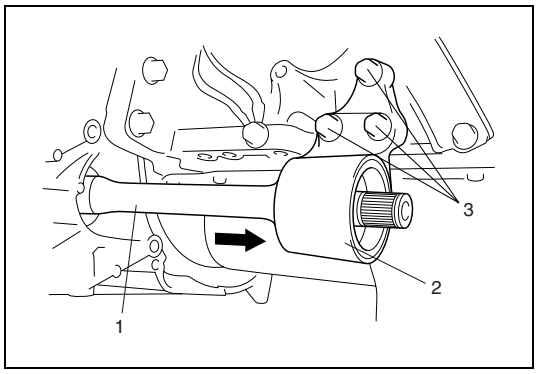
11) Remove drive shaft assembly.

CAUTION:
To prevent breakage of boots, be careful not to bring them into contact with other parts, when removing drive shaft assembly.



12) For vehicle with center shaft
Remove center bearing support bolts (3) and remove center bearing support (2) with center shaft (1) from differential side gear.

Installation

CAUTION:
- **Be careful not to damage oil seals and boots when installing drive shaft assembly.**
- **Do not hit joint with hammer. Inserting joint only by hands is allowed.**
- **Make sure that differential side joint is inserted fully and its snap ring is seated as it was.**

Install drive shaft assembly by reversing removal procedure noting the following points.
- Install wheel side joint to steering knuckle first, and then differential side joint to transaxle.
- Tighten each bolt and nut to the specified torque referring to “Front Drive Shaft Assembly Construction” in this section.
- Fill transaxle with oil referring to “Oil Change” in Section 7A or “Manual Transaxle Oil Change” in Section 7A1.
- Fill transfer with oil (4WD model) referring to “Oil Change” in Section 7D.
- Check toe setting and adjust referring to “Toe Setting” and “Toe Adjustment” in Section 3A.

Front Drive Shaft Assembly Inspection

- Check boots for breakage or deterioration.
- Check wheel side joint for rattle or smoothness.
- Check differential side joint for smoothness.
If any abnormality is found, replace.

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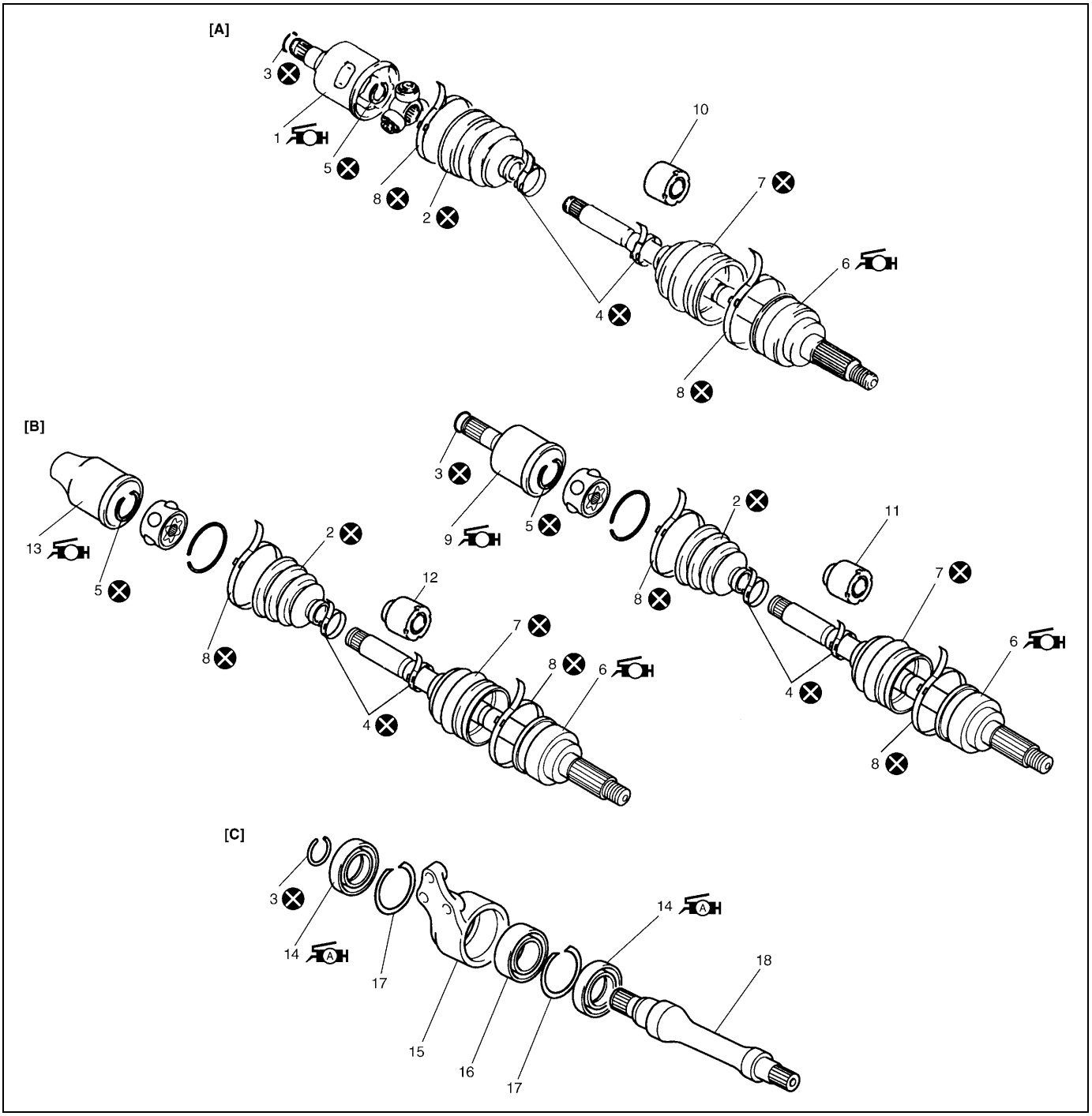
Front Drive Shaft Components



[A]: Tripod joint type	6. Wheel side joint (Constant velocity ball joint) : Apply dark gray grease included in spare part to joint.	14. Oil seal : Apply grease 99000-25010 to oil seal lip.
[B]: DOJ type	7. Boot (Wheel side)	15. Center bearing support
[C]: Center shaft for 2WD model	8. Boot band (Large)	16. Center bearing
1. Differential side joint (RH of 2WD M/T model) : Apply orange grease included in spare part to joint.	9. Differential side joint (LH of all models) : Apply black grease included in spare part to joint.	17. Circlip
2. Boot (Differential, transfer or center shaft side)	10. Damper (RH of 2WD M/T model with M13 engine)	18. Center shaft
3. Circlip	11. Damper (LH of 2WD A/T model)	⊗ Do not reuse.
4. Boot band (Small)	12. Damper (RH of 2WD M/T model with M15 engine)	
5. Snap ring	13. Transfer side (RH of 4WD model) and center shaft side (RH of 2WD A/T model) joint : Apply black grease included in spare part to joint.	

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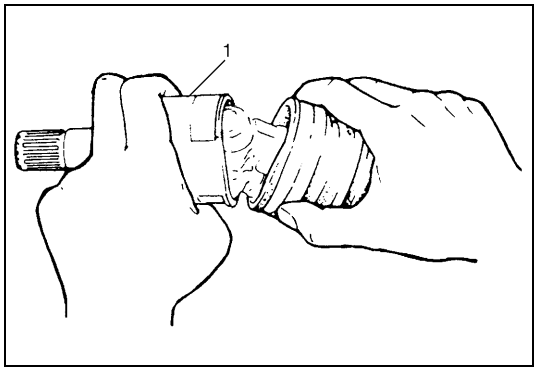
Front Drive Shaft Disassembly and Assembly

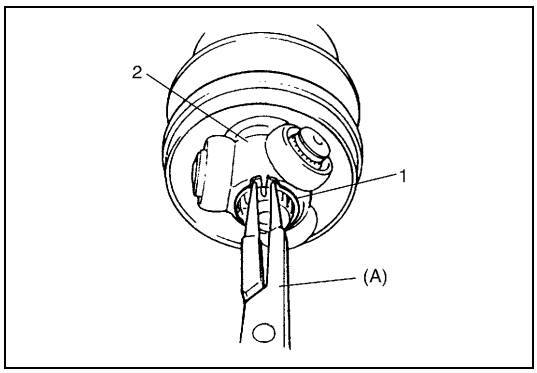
CAUTION:
- **Disassembly of wheel side joint is not allowed. If noise or damage exists in it, replace it as assembly.**
- **Do not disassemble tripod joint spider. If any malcondition is found in it, replace it as differential side joint assembly.**

Disassembly

For Tripod Joint Type



1) Remove differential side boot big band, then take out tripod joint housing (1).



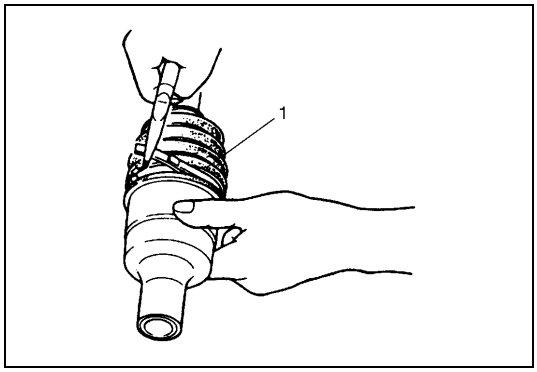
2) Wipe off grease from shaft and take off snap ring (1) by using special tool, then pull out spider (2) from shaft.

Special tool
(A): 09900-06107

CAUTION:
To prevent needle bearing of joint from being degreased, do not wash it if it is to be reused.

3) Remove differential side boot small band, then pull out differential side boot from shaft.
4) Pull out damper through shaft, if equipped.
5) Undo boot bands of wheel side boot, then pull out boot through shaft.

For DOJ Type



1) Remove differential side boot big band (1).

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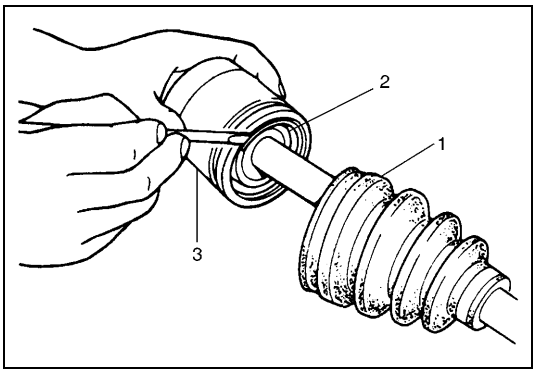
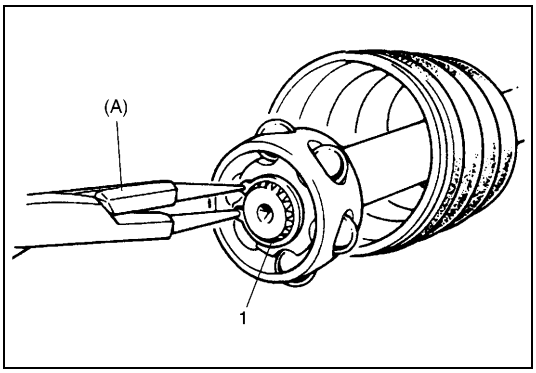
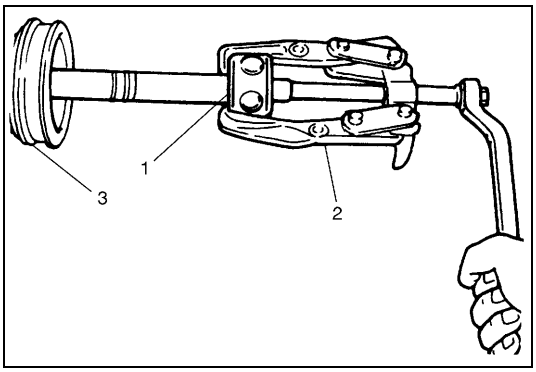


2) Slide boot (1) toward the center of shaft and remove snap ring (2) from outer race, then take shaft out of outer race (3).



3) Wipe off grease and remove circlip (1) used to fix cage by using special tool (A).

Special tool
(A): 09900-06107



4) Draw away cage (1) by using bearing puller (2), and remove boot (3) from shaft.

5) Remove differential side boot small band, then pull out differential side boot from shaft.
6) Pull out damper through shaft, if equipped.
7) Undo boot bands of wheel side boot, then pull out boot through shaft.

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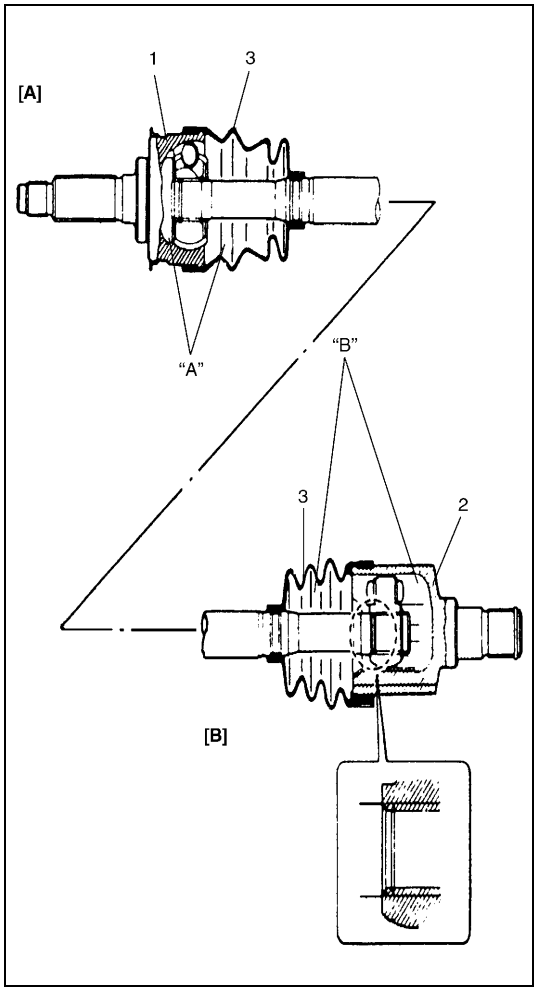
Assembly

For Tripod Joint Type



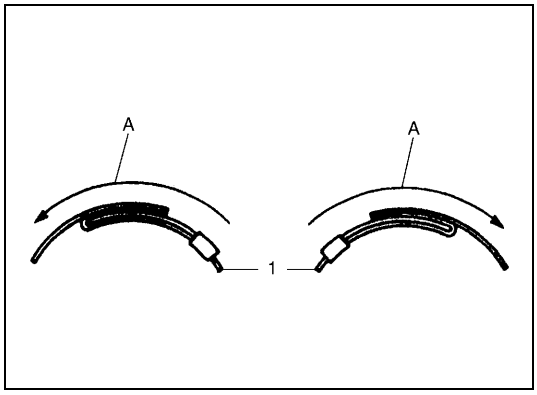
Judging from abnormality noted before disassembly and what is found through visual check of component parts after disassembly, prepare replacing parts and proceed to reassembly.
Make sure that wheel side joint assembly (1) and tripod joint housing (2) are washed thoroughly and air dried, and boots (3) are cleaned with cloth if they are to be reused.

CAUTION:
- **Do not wash boots in degreaser, such as gasoline or kerosene, etc. Washing in degreaser causes deterioration of boot.**
- **To ensure full performance of joint as designed, be sure to distinguish between two types of grease in repair set and apply specified volume to respective joint. Refer to the followings for identification of the grease.**

"A": Dark gray grease (approx. 60 – 80 g/2.1 – 2.8 oz)
"B": Orange grease (approx. 85 – 105 g/3.0 – 3.7 oz)

[A]:	Wheel side
[B]:	Differential side

1) Wash disassembled parts (except boots). After washing, dry parts completely by blowing air.
2) Clean boots with cloth.
3) Apply grease to wheel side joint. Use specified grease in tube in wheel side boot set.
4) Install wheel side boot on shaft.



5) Fill up boot inside with specified grease and then fasten boot with bands (1).

CAUTION:
- **Bend each boot band against forward rotation (A).**
- **Do not squeeze or distort boot when fastening it with bands.**
  Distorted boot caused by squeezing air may reduce its durability.

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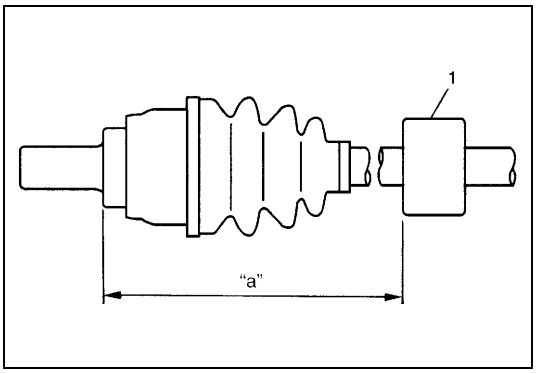
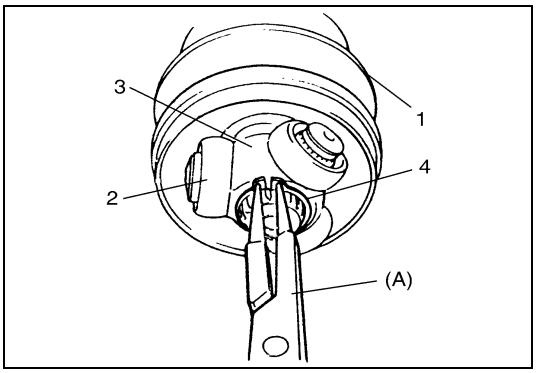


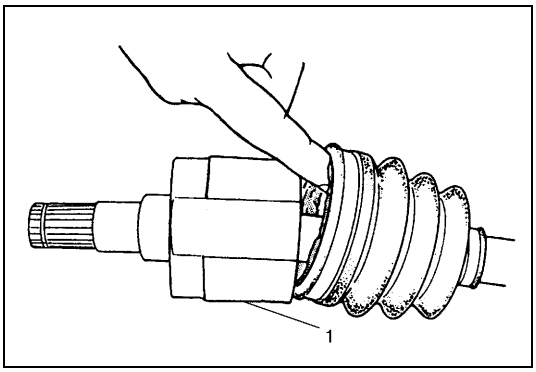
6) Install damper (1) on drive shaft according to dimension specified below.

Drive shaft dynamic damper installing position
"a": 337 – 343 mm (13.27 – 13.50 in.)

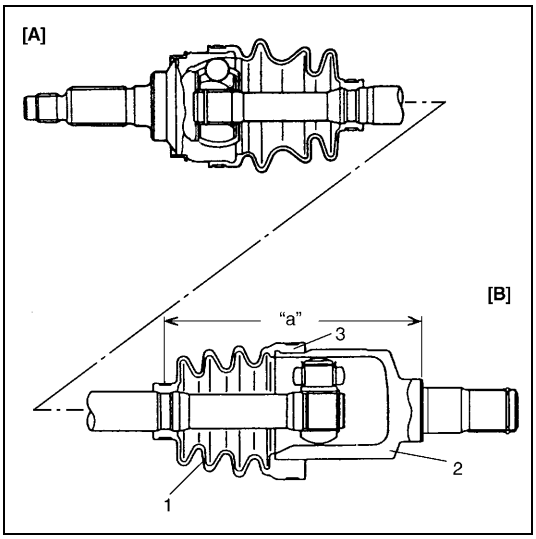


7) Set new differential side small band and differential side boot (1) on shaft temporarily.
Apply grease to tripod joint (2). Use specified grease in tube included in spare parts.
8) Install tripod joint spider (3) on shaft, facing its chamfered spline inward (wheel side), then fasten it with snap ring (4).

Special tool
(A): 09900-06107



9) Apply grease to inside of outer race (1), then install housing, joint it with boot and fit boot to outer race.
After fitting boot, insert screwdriver into boot on outer race side and allow air to enter boot so that air pressure in boot becomes the same as atmospheric pressure.



10) When fixing boot (1) to outer race (2) with differential side big band (3), adjust so that measured dimensions become as indicated below.

Drive shaft boot fixing position
"a": 150.5 – 160.5 mm (5.93 – 6.31 in.)

CAUTION:
To prevent any problem caused by washing solution, do not wash joint boots and tripod joint except its housing. Degreasing of those parts with cloth is allowed.

[A]:	Wheel side
[B]:	Differential side

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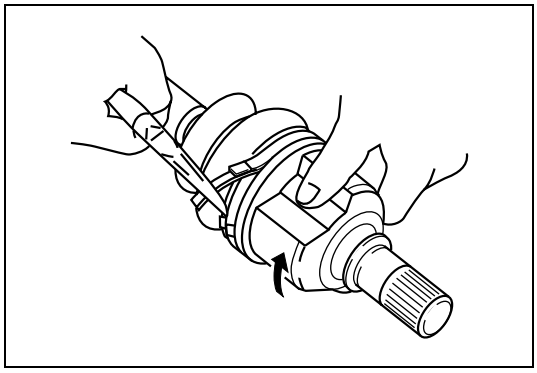
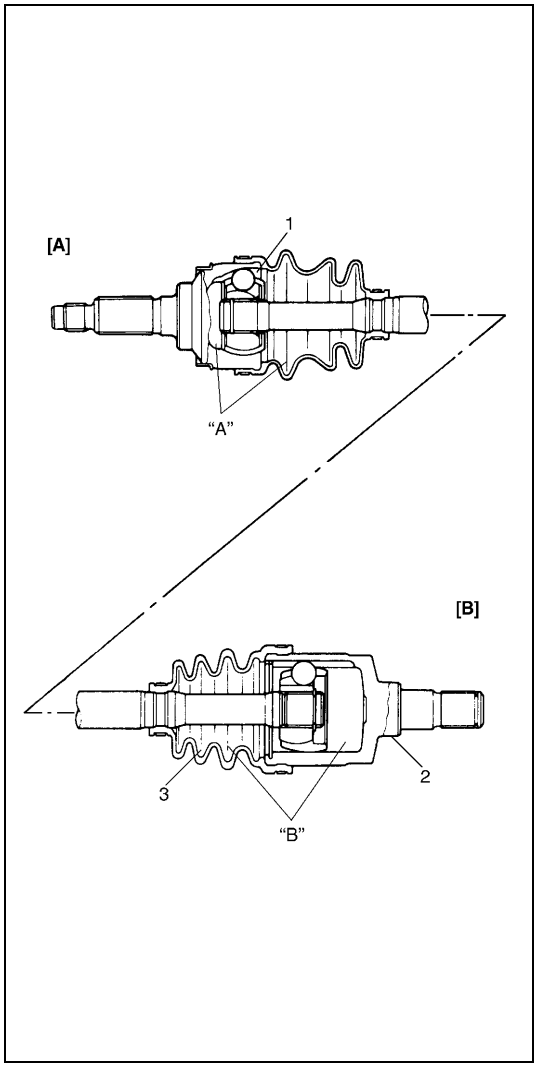


CAUTION:

- **Bend each boot band against forward rotation.**
- **Do not squeeze or distort boot when fastening it with bands.**
  Distorted boot caused by squeezing air may reduce its durability.

For DOJ Type



Judging from abnormality noted before disassembly and what is found though visual check of component parts after disassembly, prepare replacing parts and proceed to reassembly.
Make sure that wheel side joint assembly (1) and DOJ housing (2) are washed thoroughly and air dried, and boots (3) are cleaned with cloth if they are to be reused.

CAUTION:

- **Do not wash boots in degreaser, such as gasoline or kerosene, etc. Washing in degreaser causes deterioration of boot.**
- **To ensure full performance of joint as designed, be sure to distinguish between two types of grease in repair set and apply specified volume to respective joint.**

For M13 engine
"A": Dark gray grease (approx. 60 – 80 g/2.1 – 2.8 oz)
"B": Dark gray grease (approx. 70 – 90 g/2.5 – 3.2 oz)
For M15 engine (right side)
"A": Black grease (approx. 45 – 65 g/1.6 – 2.3 oz)
"B": Dark gray grease (approx. 70 – 90 g/2.5 – 3.2 oz)
For M15 engine (left side)
"A": Black grease (approx. 45 – 65 g/1.6 – 2.3 oz)
"B": Dark gray grease (Approx. 65 – 85 g/2.3 – 3.2 oz)

[A]:	Wheel side
[B]:	Differential side

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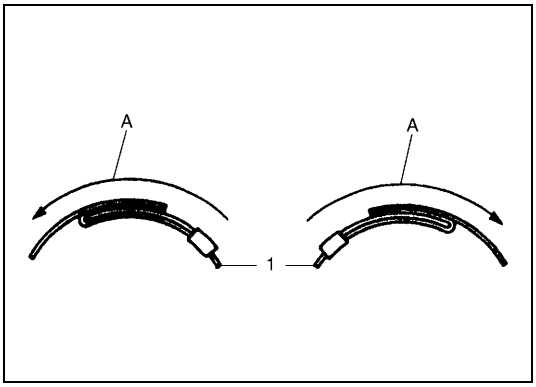
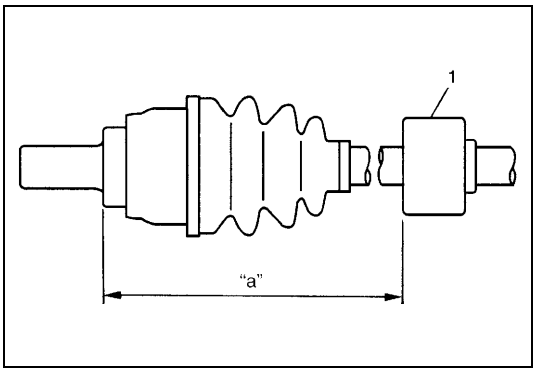
1) Wash disassembled parts (except boots). After washing. dry parts completely by blowing air.
2) Clean boots with cloth.
3) Apply grease to wheel side joint. Use specified grease in tube included in wheel side boot set.



4) Install wheel side boot on shaft, fill up boot inside with grease and then fasten boot with bands (1).

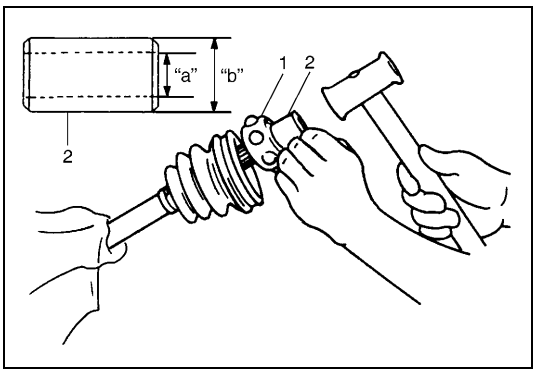
CAUTION:
- **Bend each boot band against forward rotation (A).**
- **Do not squeeze or distort boot when fastening it with bands.**
  Distorted boot caused by squeezing air may reduce its durability.



5) Install damper (1) on drive shaft according to dimension specified below.

Damper installing position
For M13 engine model
"a": 151 – 157 mm (5.95 – 6.18 in.)
For M15 engine model
"a": 154.3 – 160.3 mm (6.08 – 6.31 in.)

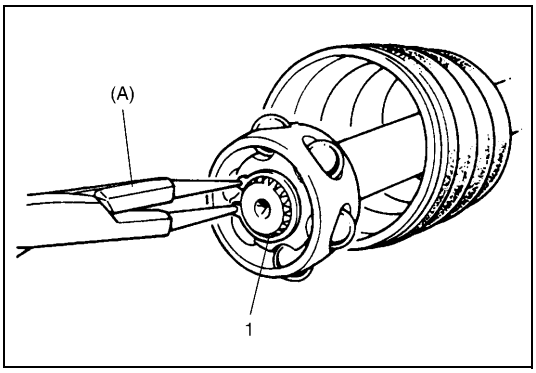
6) Set new differential side small band and differential side boot on shaft temporarily.



7) Drive in the cage (1) by using a pipe (2).

Drive shaft joint cage installing pipe diameter
"a": 22.5 mm (0.886 in.) or more
"b": 30.0 mm (1.181 in.) or less

CAUTION:
Install cage directing smaller outside diameter side to wheel side.



8) Install circlip (1) by using special tool (A).

Special tool
(A): 09900-06107

9) Apply grease to entire surface of cage.
   Use specified grease in tube included in spare parts.

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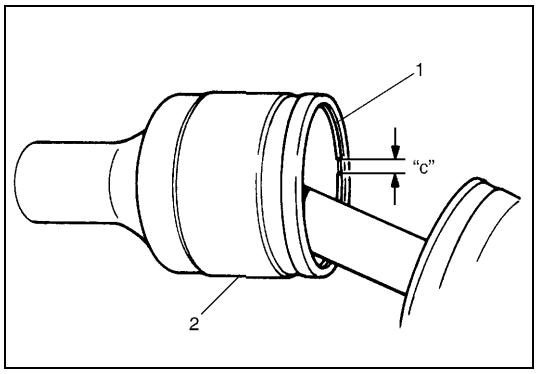
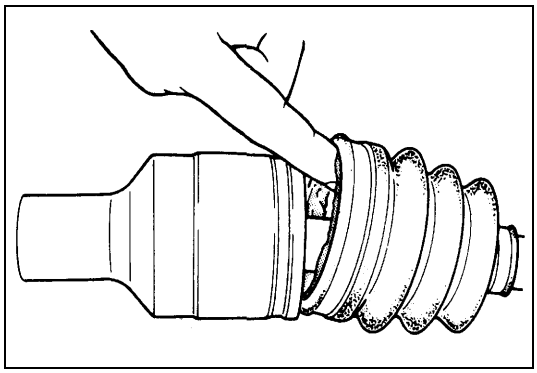
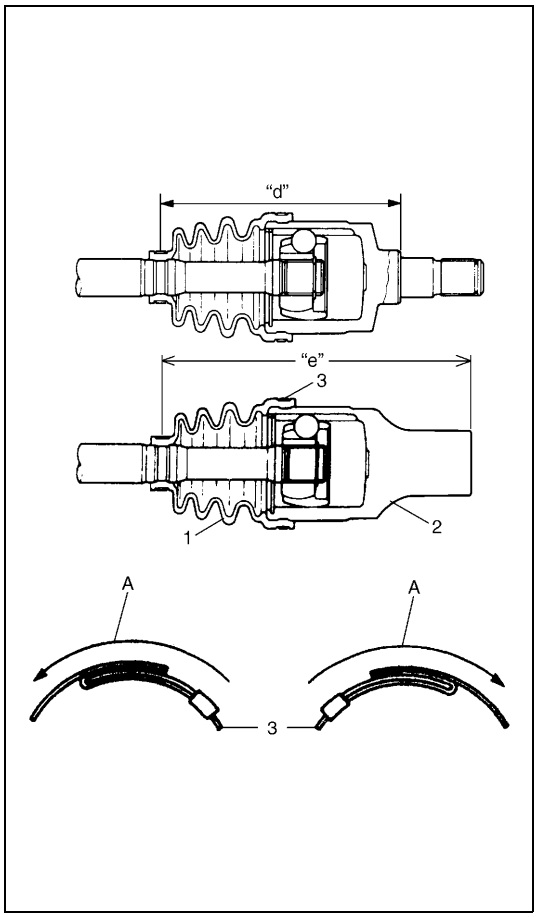


10) Insert cage into outer race and fit snap ring (1) into groove of outer race (2).

CAUTION:
Position opening of snap ring "c" so that it will not be lined up with a ball.



11) Apply grease to inside of outer race, and fit boot to outer race. After fitting boot, insert screwdriver into boot on outer race side and allow air to enter boot so that air pressure in boot becomes the same as atmospheric pressure.



12) When fixing boot (1) to outer race (2) with differential side big band (3), adjust so that measurements become as indicated below.

Drive shaft boot fixing position
For left side
"d": 152.8 – 162.8 mm (6.02 – 6.40 in.) for M13 engine model
"d": 160.5 – 170.5 mm (6.32 – 6.71 in.) for M15 engine model
For right side
"e": 187.9 – 197.9 mm (7.40 – 7.79 in.) for 2WD A/T of M13 engine model and 4WD of M13 engine model
"e": 188.0 – 198.0 mm (7.41 – 7.79 in.) for M15 engine model

CAUTION:
- **Bend each boot band against forward rotation (A).**
- **Do not squeeze or distort boot when fastening it with bands.**
  Distorted boot caused by squeezing air may reduce its durability.

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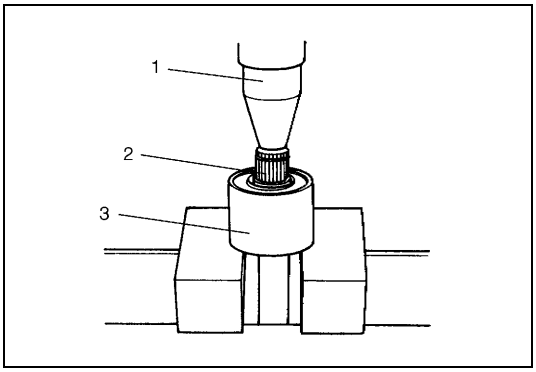
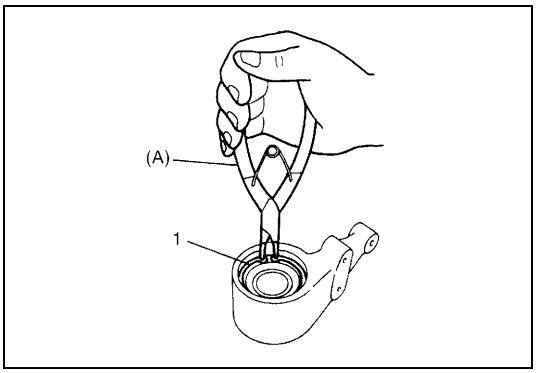
For Center Shaft and Center Bearing Support Disassembly and Assembly (2WD Model)

Disassembly



1) Using hydraulic press (1), draw out center shaft (2) from center shaft support bearing.
2) Remove oil seals from center bearing support (3).

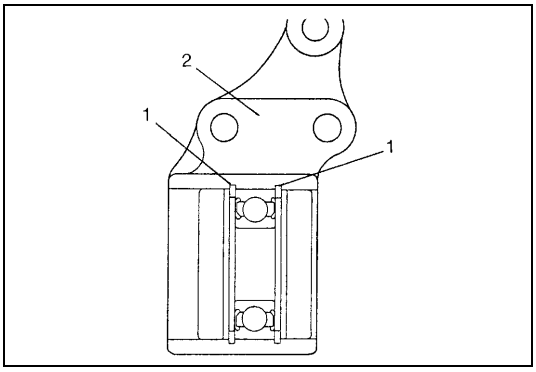


3) Remove bearing support circlips (1) by using special tool.

Special tool
(A): 09900-06108

4) Remove center shaft support bearing from center bearing support.

Assembly



Install center shaft by reversing removal procedure and noting following points

- When installing circlips (1), make sure that it fits in circlips groove in center bearing support (2) securely as shown.

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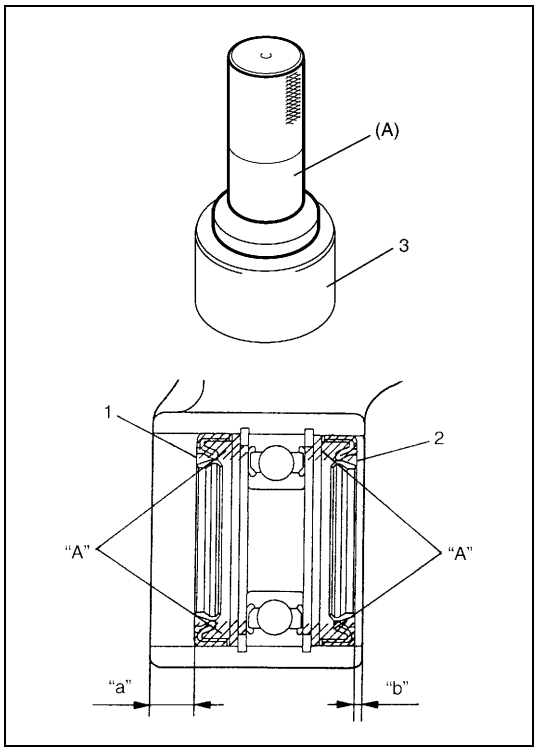


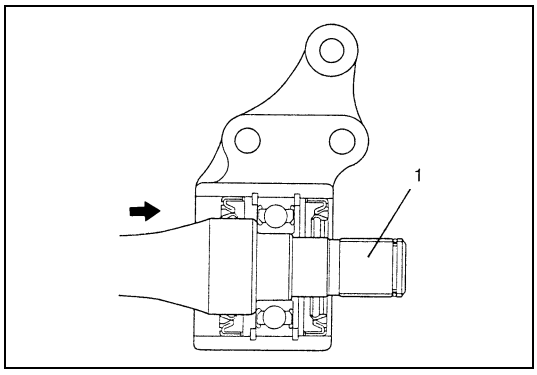
- When installing left oil seal (1) and right oil seal (2) to center bearing support (3) by using special tool, use care so that the oil seals installed in proper direction and position as shown figure.

Special tool
(A): 09925-15410

Distance
"a": 8 – 9 mm (0.31 – 0.35 in.)
"b": 2 – 3 mm (0.08 – 0.12 in.)

- Be sure to apply grease to oil seal lip and bearing side space indicated in figure.

"A": Grease 99000-25010



- Press-fit center shaft (1) from transaxle side.

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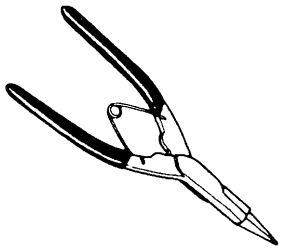
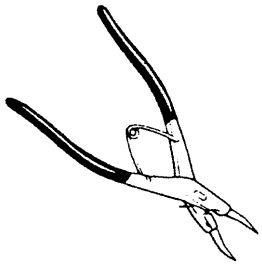
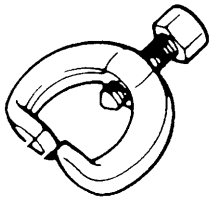
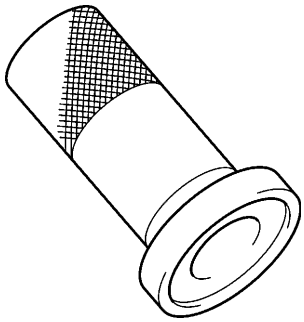
Tightening Torque Specification

Fastening portion	Tightening torque		
	N•m	kg-m	lb-ft
Transaxle oil filler/level and drain plugs	21	2.1	15.5
Ball stud bolt	60	6.0	43.5
Tie rod end castle nut	35 – 50	3.5 – 5.0	25.5 – 36.0
Drive shaft nut	175	17.5	127.0
Wheel nut	85	8.5	61.5
Center bearing support bolt	50	5.0	36.0
Stabilizer mount bracket bolt	45	4.5	32.5

Required Service Material

Material	Recommended SUZUKI product (Part Number)	Use
Lithium grease	SUZUKI SUPER GREASE A (99000-25010)	• Oil seal lips
Sealant	SUZUKI BOND NO. 1217G (99000-31260)	• Oil drain and filler plug for manual transaxle or transfer

Special Tool

			
09900-06107 Snap ring pliers (Open type)	09900-06108 Snap ring pliers (Closing type)	09913-65210 Tie-rod end remover	09925-15410 Oil seal installer

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SECTION 5

BRAKES

WARNING:

For vehicles equipped with Supplemental Restraint (Air Bag) System:

- **Service on and around the air bag system components or wiring must be performed only by an authorized SUZUKI dealer. Refer to "Air Bag System Components and Wiring Location View" under "General Description" in air bag system section in order to confirm whether you are performing service on or near the air bag system components or wiring. Please observe all WARNINGS and "Service Precautions" under "On-Vehicle Service" in air bag system section before performing service on or around the air bag system components or wiring. Failure to follow WARNINGS could result in unintentional activation of the system or could render the system inoperative. Either of these two conditions may result in severe injury.**
- **Technical service work must be started at least 90 seconds after the ignition switch is turned to the "LOCK" position and the negative cable is disconnected from the battery. Otherwise, the system may be activated by reserve energy in the Sensing and Diagnostic Module (SDM).**

NOTE:

- **When inspecting and servicing vehicle equipped with ABS, be sure to refer to section 5E first.**
- **All brake fasteners are important attaching parts in that they could affect the performance of vital parts and systems, and/or could result in major repair expense. They must be replaced with one of same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of all parts. There is to be no welding as it may result in extensive damage and weakening of the metal.**
- **For the items with asterisk (*) in the "CONTENTS" below, refer to the same section of the Service Manual mentioned in "FOREWORD" of this manual.**

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General Description

Except sport model

When the foot brake pedal is depressed, hydraulic pressure is developed in the master cylinder to actuate pistons (two in front and four in rear).
The master cylinder is a tandem master cylinder. Brake pipes are connected to the master cylinder and they make two independent circuits. One connects front right & rear left brakes and the other connects front left & rear right brakes.
The load sensing proportioning valve (LSPV) or the proportioning valve (P valve) is included in these circuits between the master cylinder and the rear brake for the vehicle without ABS.
In this brake system, the disc brake type is used for the front wheel brake and a drum brake type (leading/trailing shoes) for the rear brake.
The parking brake system is mechanical. It applies brake force to only rear wheels by means of the cable and mechanical linkage system. The same brake shoes are used for both parking and foot brakes.

Sport model

When the foot brake pedal is depressed, hydraulic pressure is developed in the master cylinder to actuate pistons (two in front and rear).
The master cylinder is a tandem master cylinder. Brake pipes are connected to the master cylinder and they make two independent circuits. One connects front right & rear left brakes and the other connects front left & rear right brakes.
The proportioning valve (P valve) is included in these circuits between the master cylinder and the rear brake.
In this brake system, the disc brake type is used for the front and rear wheel brake.
The parking brake system is mechanical. It applies brake force to only rear wheels by means of the cable and mechanical linkage system. The same brake pads are used for both parking and foot brakes.

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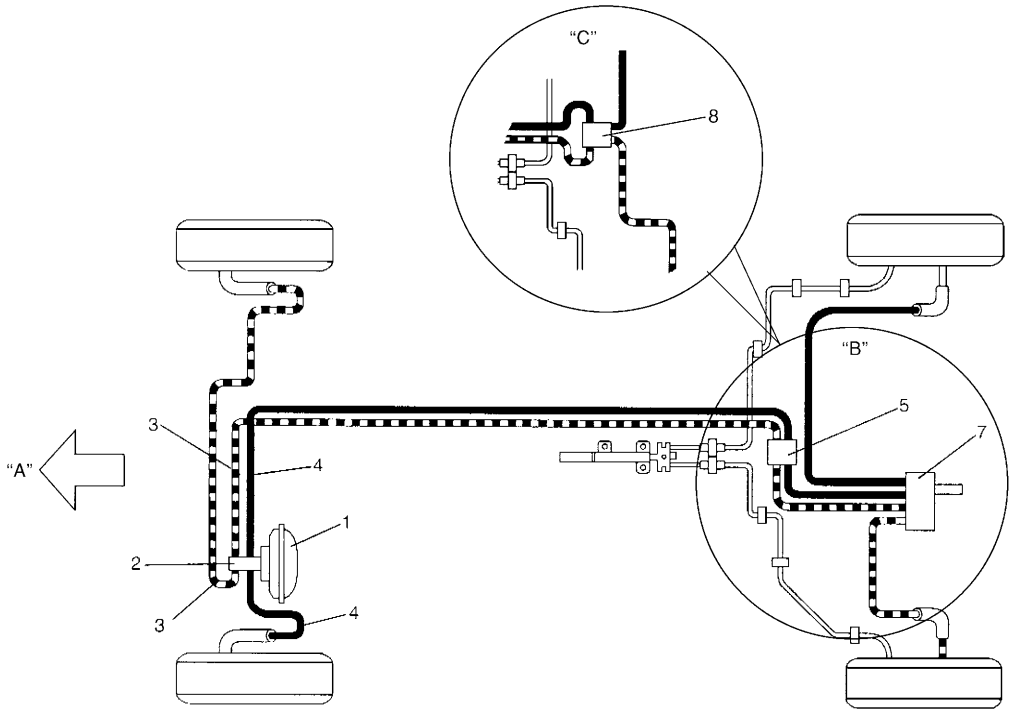
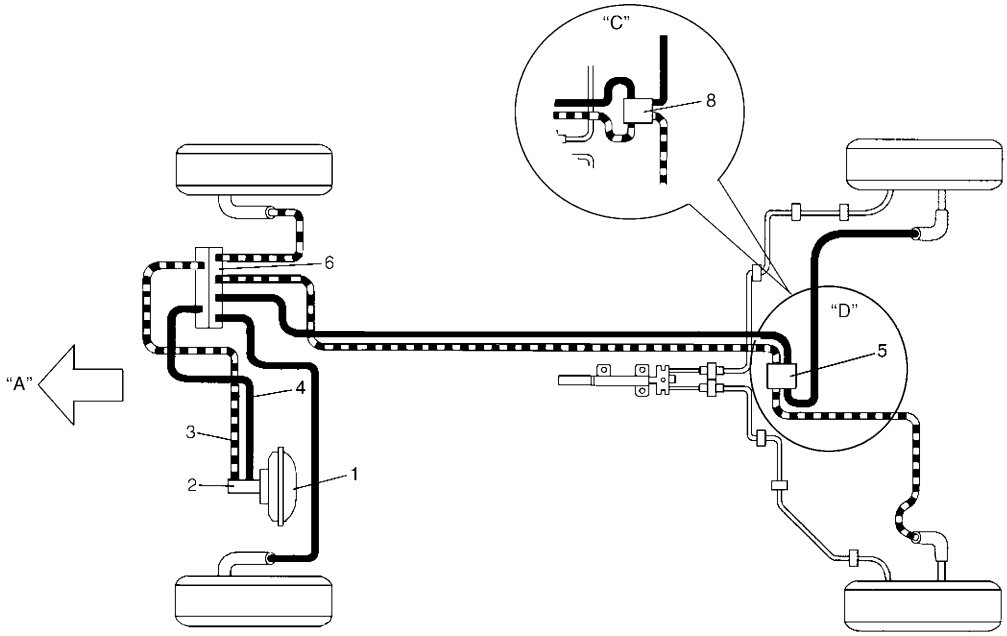
NOTE:

The figures shows left-hand steering vehicle.

[A]



[B]



[A]: For vehicle without ABS	"C" with P valve type	3. Secondary side	7. LSPV (Load Sensing Proportioning valve)
[B]: For vehicle with ABS	"D" with 4-way joint type	4. Primary side	8. P (Proportioning) valve
"A" Forward	1. Brake booster	5. 4-way joint	
"B" with LSPV valve type	2. Master cylinder	6. ABS hydraulic unit/control module assembly	

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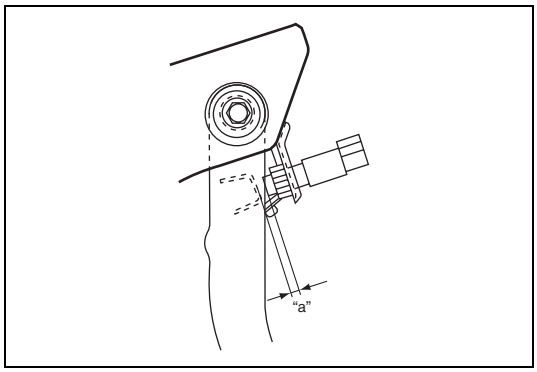
Diagnosis

Stop Light Switch Adjustment

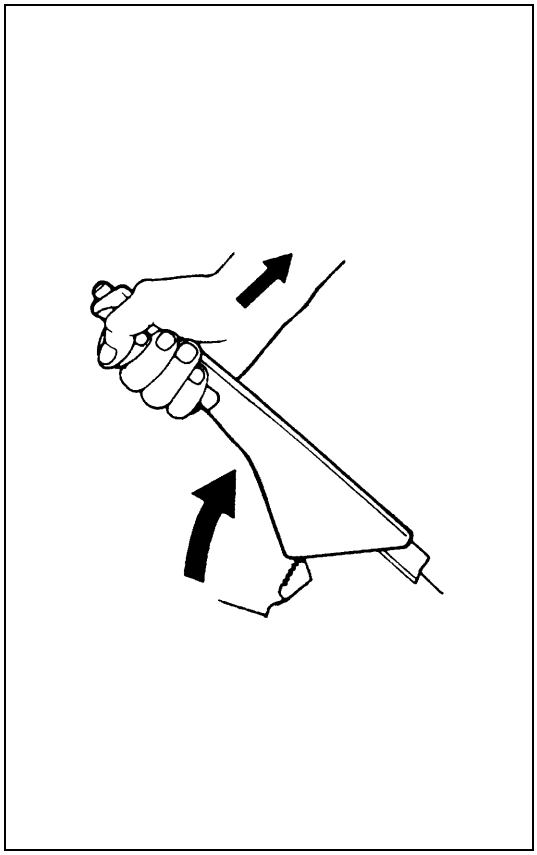


Adjustment should be made as follows when installing switch. Pull up brake pedal toward you and while holding it there, adjust switch position so that clearance between end of thread and brake pedal is as specified. Then adjust stop light switch assembly position and lock it by turning clockwise.

Clearance between brake pedal and stop light switch "a": 1.5 – 2.5 mm (0.06 – 0.09 in.)

Parking Brake Inspection and Adjustment

Inspection



Hold center of parking brake lever grip and pull it up.
With parking brake lever pulled up as shown, count ratchet notches.
Also, check if both right and left rear wheels are locked firmly.
To count number of notches easily, listen to click sounds that ratchet makes while pulling parking brake lever without pressing its button.
One click sound corresponds to one notch.
If number of notches is out of specification, adjust cable referring to adjustment procedure so as to obtain specified parking brake store.

NOTE:

Check tooth tip of each notch for damage or wear.
If any damage or wear is found, replace parking brake lever.

Parking brake lever stroke:
4 to 9 notches (When lever is pulled up at 200 N (20 kg, 44 lbs) ····· Except sport model

5 to 10 notches (When lever is pulled up at 150 N (15 kg, 33 lbs) ····· Sport model

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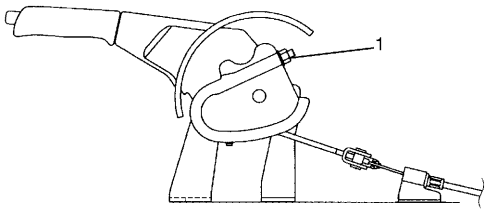
Adjustment



NOTE:

Make sure for the following conditions before cable adjustment.

- **No air is trapped in brake system.**
- **Brake pedal travel is proper.**
- **Brake pedal has been depressed a few times with about 300 N (30 kg, 66 lbs) load.**
- **Parking brake lever is pulled up a few times with about 200 N (20 kg, 44 lbs) (Except sport model) or 150 N (15 kg, 33 lbs) (sport model) force.**
  If parking brake cable is replaced with new one, pull up parking brake lever a few times with about 500 N (50 kg, 110 lbs) force.
- **Rear brake shoes (or pad) are not worn beyond limit, and self adjusting mechanism operates properly.**
- **If parking brake lever stroke is less than specification, loosen adjusting nut (1) as far as end of bolt. Then depress brake pedal repeatedly with about 300 N (30 kg, 66 lbs) load until adjuster actuator clicking sound can not be heard from drum brake (if equipped brake drum).**

After confirming that above conditions are all satisfied, adjust parking brake lever stoke by loosening or tightening adjust nut (1).

CAUTION:

Check brake drum (or brake disc) for dragging after adjustment.

Parking brake lever stroke:
4 to 9 notches (When lever is pulled up at 200 N (20 kg, 44 lbs) ····· Except sport model

5 to 10 notches (When lever is pulled up at 150 N (15 kg, 33 lbs) ····· Sport model

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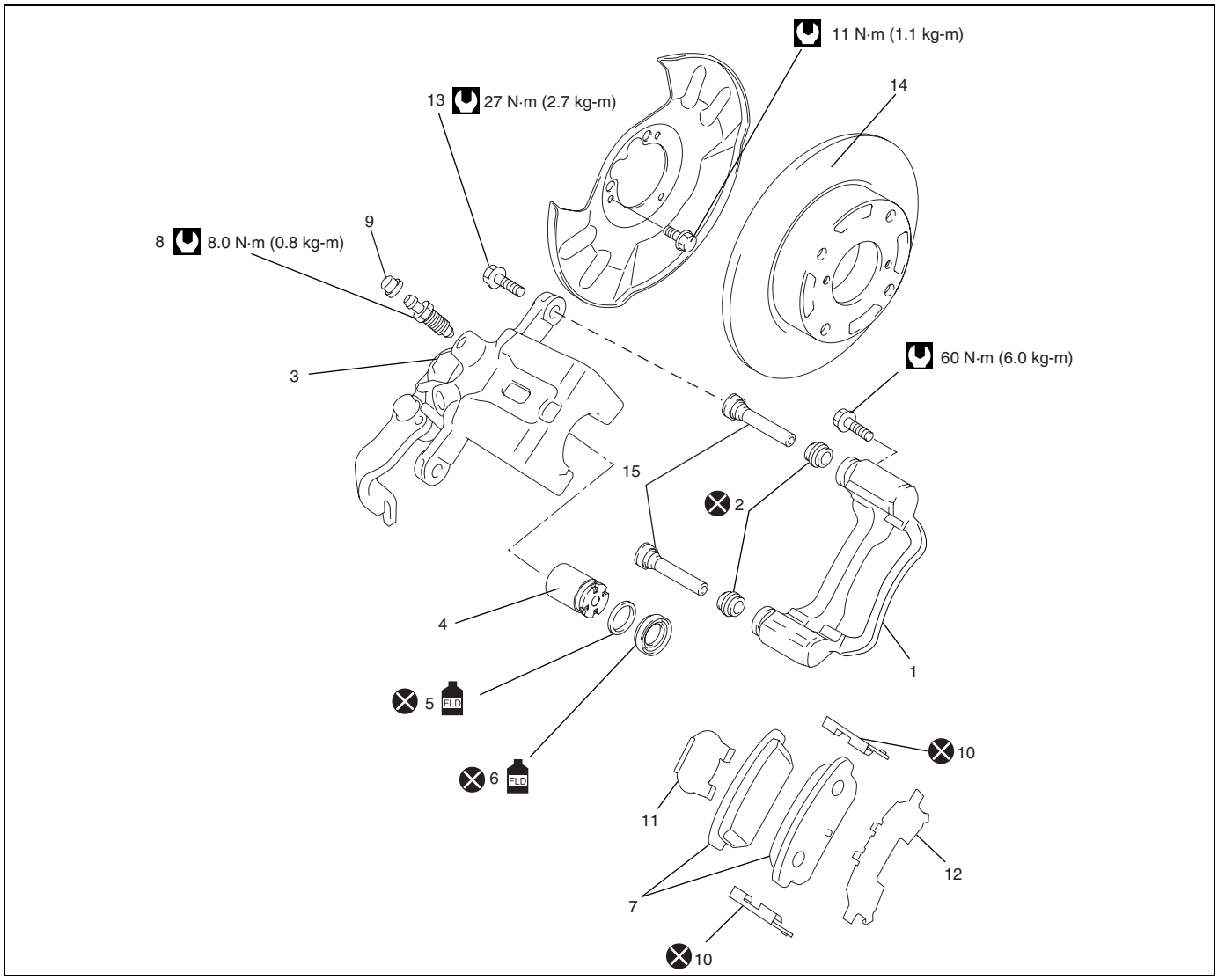
On-Vehicle Service

Rear Brake (Sport Model)



	1. Brake caliper carrier		10. Pad spring
	2. Boot		11. Anti noise shim (inside)
	3. Caliper		12. Anti noise shim (outside)
	4. Disc brake piston		13. Caliper pin bolt
FLD	5. Piston seal : Apply fluid (Brake fluid).		14. Brake disc
FLD	6. Cylinder boot : Apply fluid (Brake fluid).		15. Slide pin : Apply rubber grease.
	7. Brake pad		Tightening torque
	8. Bleeder plug		Do not reuse.
	9. Bleeder plug cap		

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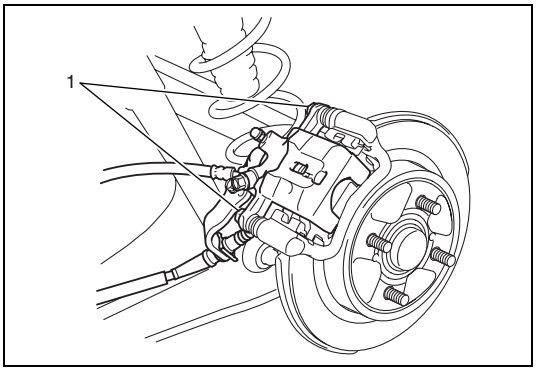
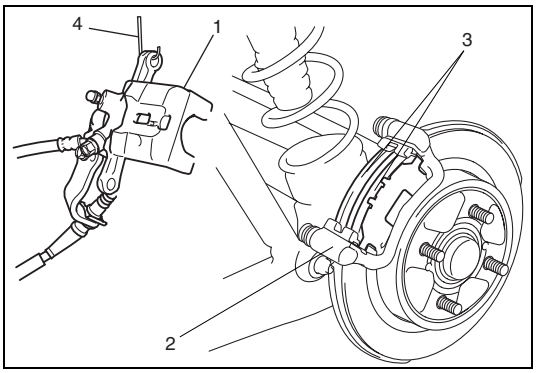
Rear brake pad

Removal

1) Loosen wheel nuts and with vehicle lifted up, remove wheels.
2) Release parking brake lever.



3) Remove caliper pin bolts (1).



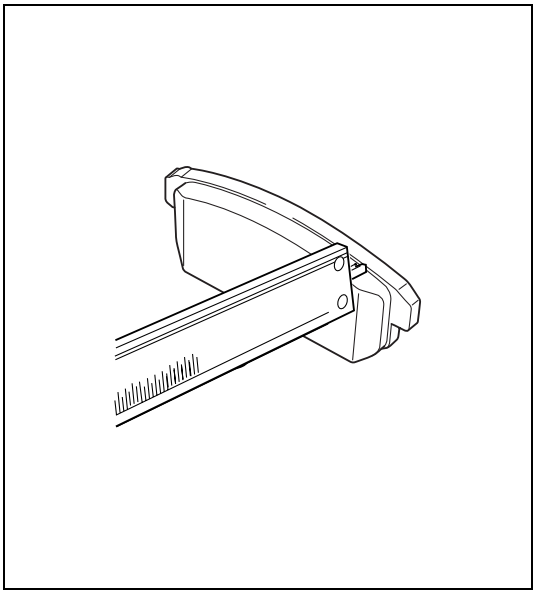
4) Remove caliper (1) from caliper carrier (2).

NOTE:

Hang removed caliper (1) with a wire hook (4) or the like so as to prevent brake hose from bending and twisting excessively or being pulled.
Don't operate brake pedal with brake pads removed.

5) Remove brake pads (3) and pad springs.

Inspection



Check pad lining for wear. When wear exceeds limit, replace with new one.

CAUTION:

Never polish pad lining with sandpaper. If lining is polished with sandpaper, hard particles of sandpaper will be deposited in lining and may damage disc. When pad lining requires correction, replace it with a new one.

Brake pad thickness (lining thickness)
Standard: 7.5 mm (0.295 in.)
Limit: 1.5 mm (0.059 in.)

NOTE:

When pads are removed, visually inspect caliper for brake fluid leak. Correct leaky point, if any.

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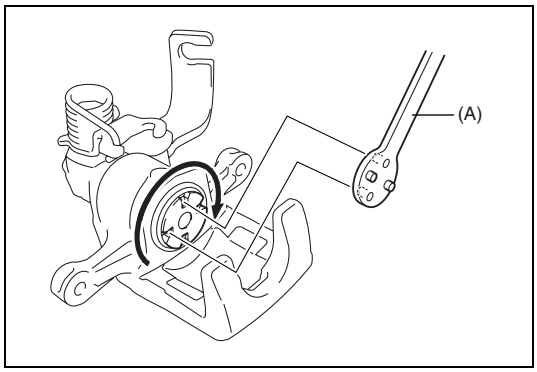
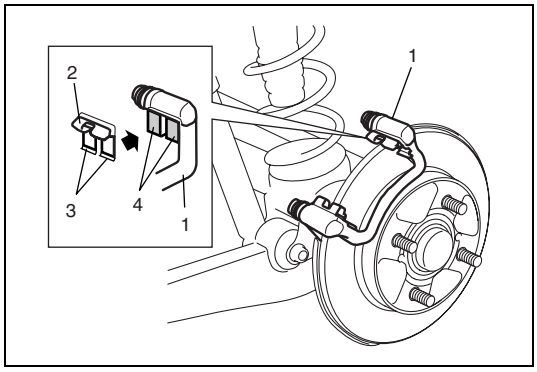
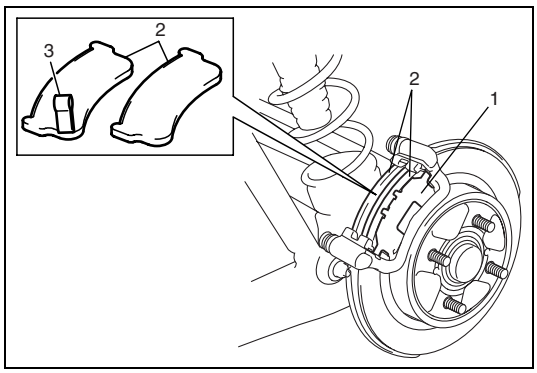
Installation



1) Turn brake caliper piston clockwise to obtain clearance between brake disc and pads.
   Special tool
   (A): 09945-16060



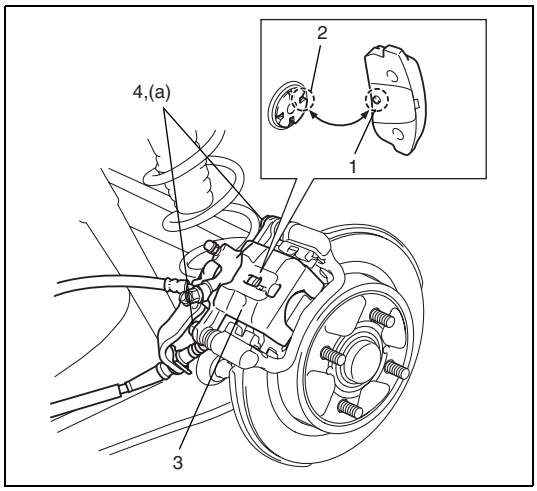
2) Clean (and degrease) pad spring installation face (4) of caliper carrier (1).
3) After peeling off each sheet (tape) (3) from new pad spring (2), attach pad spring (2) to carrier (1).



4) Install shims (1) and brake pads (2).

   NOTE:

   For right side brake, install pad with wear indicator (3) to vehicle center side.



5) With lug (1) of brake pad matched with dent (2) of brake piston, install caliper (3) to carrier.
6) Tighten caliper pin bolts (4) to specified torque.

   Tightening torque
   Caliper pin bolt (a): 27 N·m (2.7 kg-m, 19.5 lb-ft)

7) Tighten wheel nuts temporarily and lower lift.

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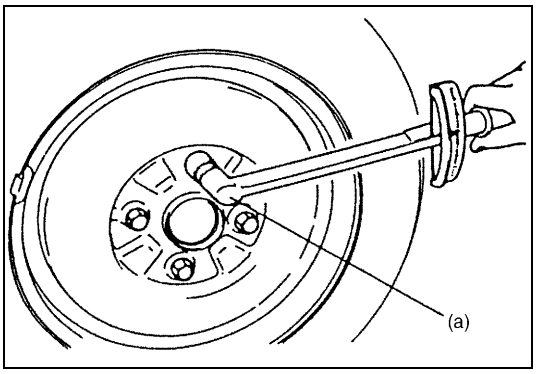


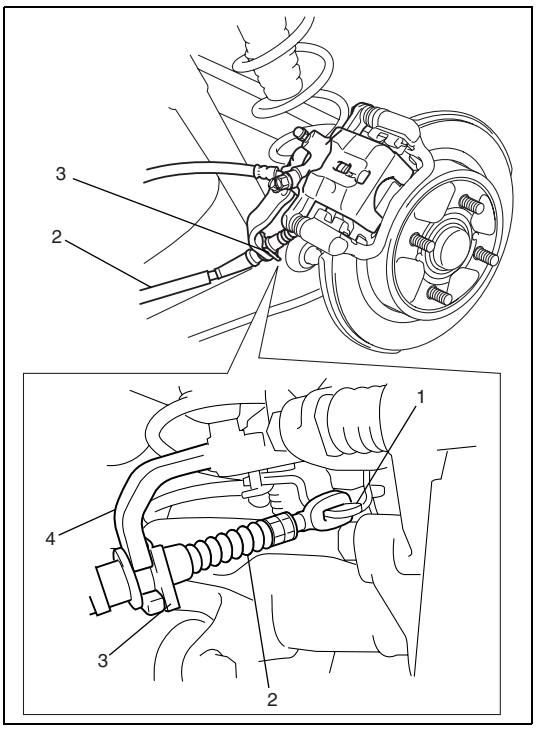
8) Tighten wheel nuts to specified torque.

Tightening torque
Wheel nut (a): 85 N·m (8.5 kg-m, 61.5 lb-ft)

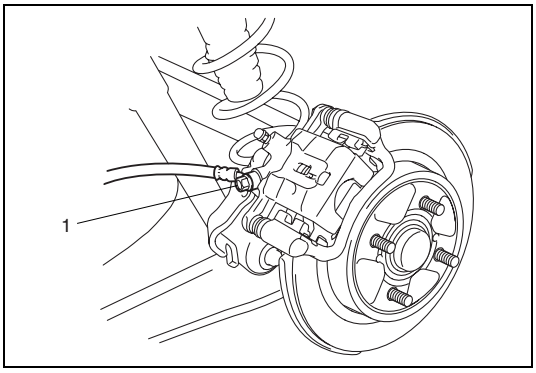
9) After completion of installation, check for brake effectiveness.

Rear brake caliper assembly

Removal



1) Hoist vehicle and remove wheel.
2) Release parking brake lever.
3) Remove clip (3) and detach parking brake cable (2) from arm (4).
4) Disconnect parking brake cable (2) from brake caliper lever (1).



5) Loosen flexible hose joint bolt (1) a little.

CAUTION:
Be careful not to twist flexible hose while loosening the bolt.

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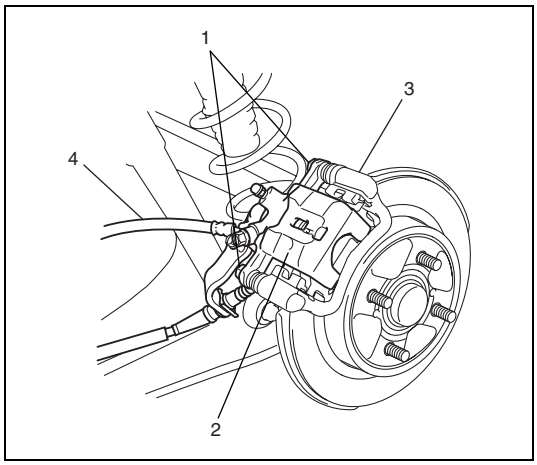
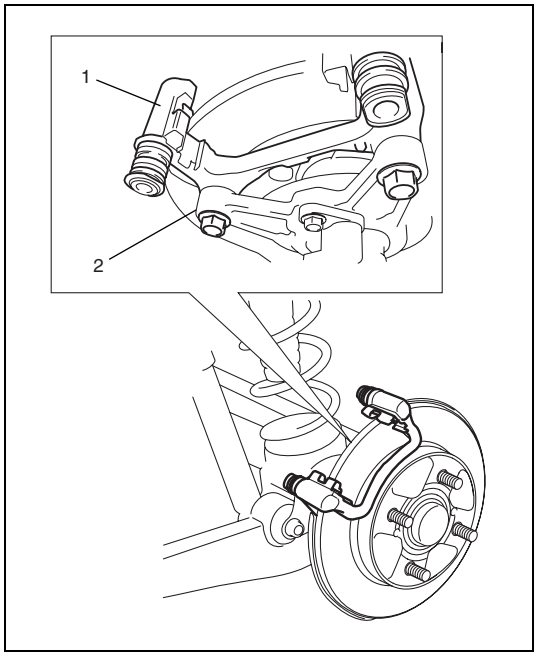


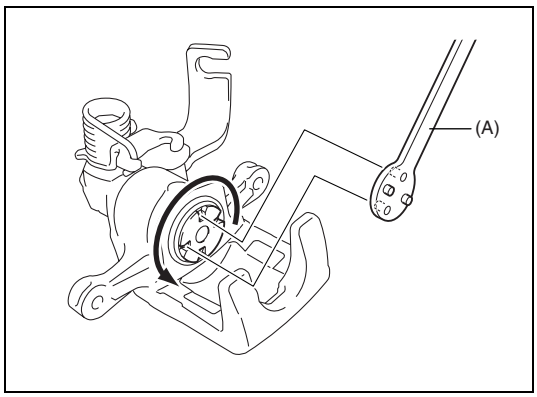
6) Remove caliper pin bolts (1).
7) Remove caliper (2) from brake caliper carrier (3).
8) Disconnect flexible hose from caliper using care not to twist it. As this will allow brake fluid to flow out of flexible hose (4), have a container ready beforehand.



9) Remove brake caliper carrier (1) from rear axle (2).

Disassembly

CAUTION:
Clean around caliper with brake fluid before disassembly.



1) Remove disc brake piston by turning piston counterclockwise with special tool.

CAUTION:
Be careful not to damage inside (bore side) of cylinder.

Special tool
(A): 09945-16060

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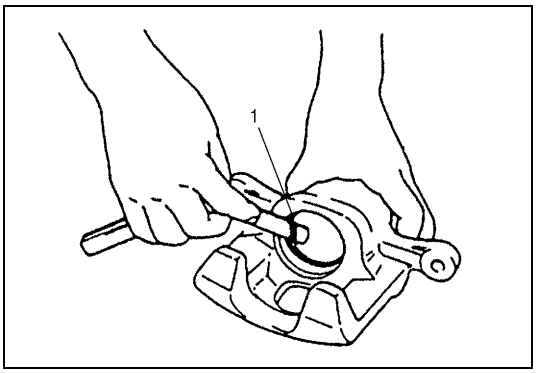


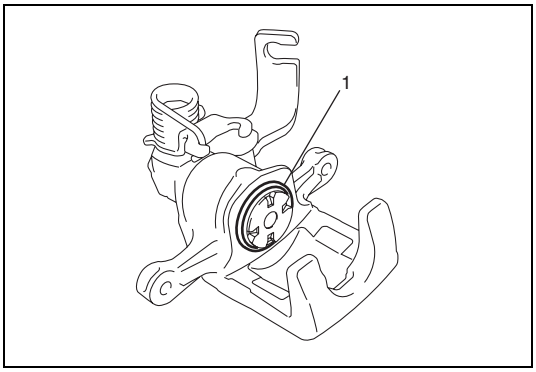
2) Remove cylinder boot and piston seal (1).

CAUTION:
Be careful not to damage inside (bore side) of cylinder.

3) Remove bleeder plug and cap from caliper.
4) Remove slide pin from brake caliper carrier.

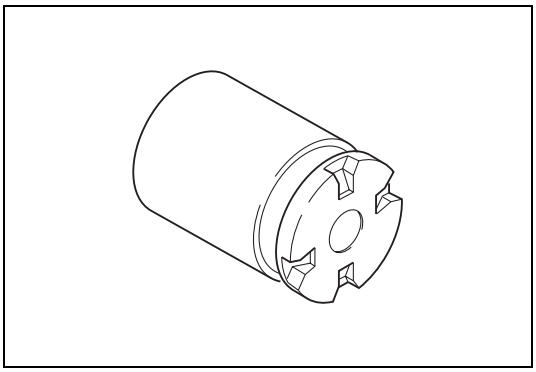
Inspection

Pin Boot and Cylinder Boot



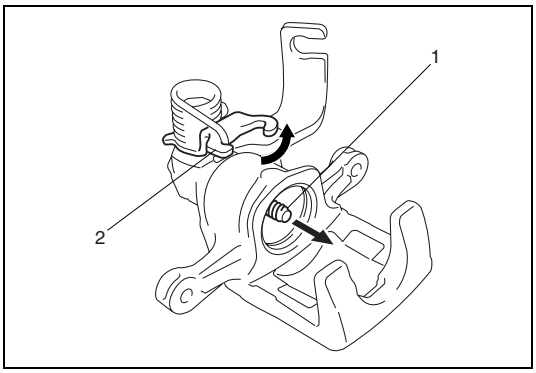
Check boots (1) for breakage, crack and damage.
If defective, replace.

Disc Brake Piston



Check all around piston for rust, corrosion and any other damage.
If it is found faulty, replace.

Caliper



Push in adjusting bolt (1) by hand and move arm (2) to check that adjusting bolt (1) moves smoothly in the arrow direction.
Also, check adjusting bolt (1) for any damage. If it is found faulty, replace.

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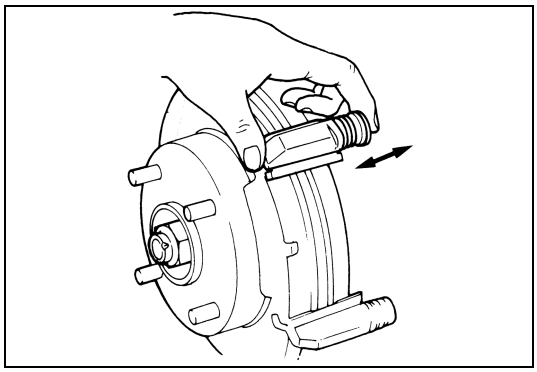
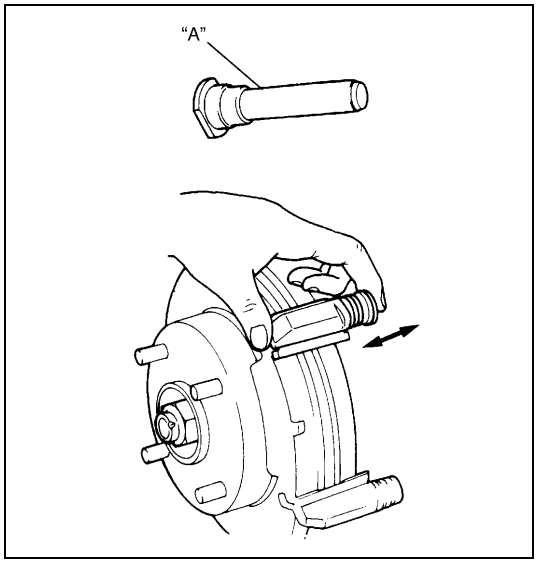
Slide Pin



Check guide pin for smooth movement as shown.
If it is found faulty, correct or replace.
Apply rubber grease to guide pin outer surface. Rubber grease should be the one whose viscosity is less affected by such low temperature as –40 °C (–40 °F).

Assembly

CAUTION:
- **Wash each part cleanly before installation in the same fluid as the one used in master cylinder reservoir.**
- **Never use other fluid or thinner.**



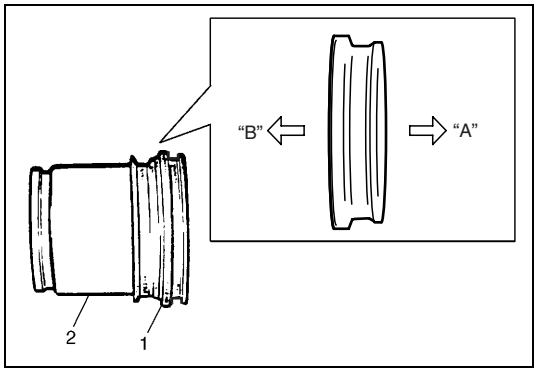
1) Install slide pin to brake caliper carrier.

CAUTION:
Before installing caliper to carrier, install slide pin with grease applied into brake caliper carrier hole and check for its smooth movement in thrust direction.

"A": Rubber grease

2) Install piston seal to caliper.

CAUTION:
- **Before installing piston seal to cylinder, apply fluid to them.**
- **Install a new piston seal into groove in cylinder securely making sure that it is not twisted.**



3) Before inserting piston (2) into cylinder, install boot (1) onto piston as shown.

"A": 1-grooved side directed cylinder side
"B": 2-grooved side directed pad side

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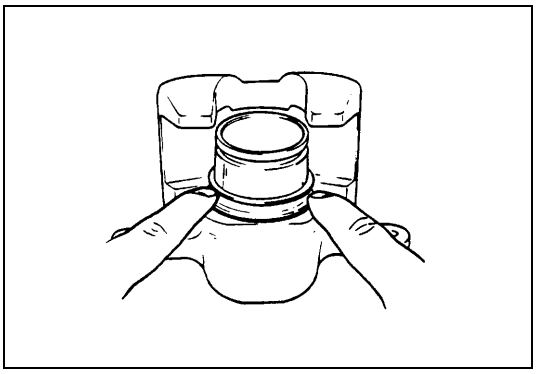
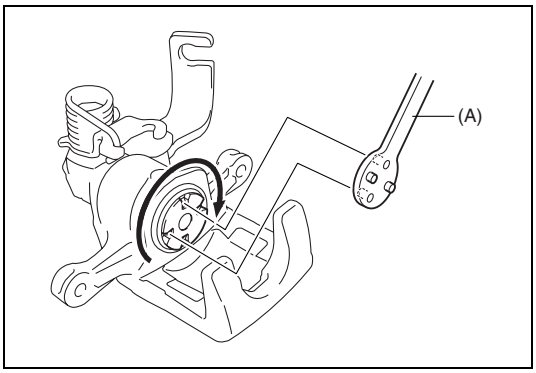


4) Fit boot as it is in figure into boot groove in cylinder with fingers.



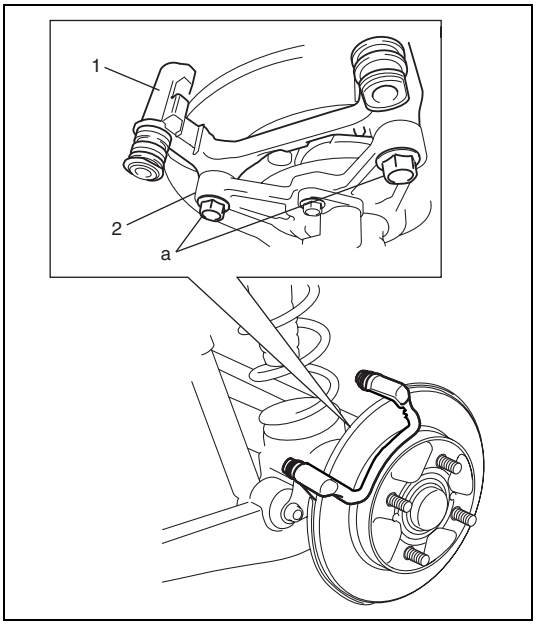
5) Turn brake caliper piston clockwise to obtain clearance between brake disc and pads.

NOTE:

Check that boot is fitted in boot groove securely all around piston.

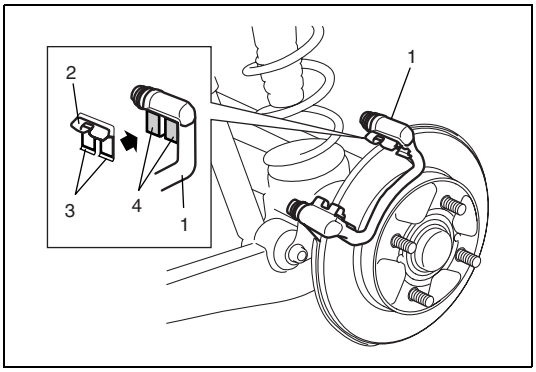
Special tool
(A): 09945-16060

Installation



1) Install brake caliper carrier (1) to rear axle (2).

Tightening torque
Brake caliper carrier bolt (a): 60 N·m (6.0 kg-m, 43.5 lb-ft)



2) Clean (and degrease) pad spring installation face (4) of caliper carrier (1).
3) After peeling off each sheet (tape) (3) from new pad spring (2), attach pad spring (2) to carrier (1).

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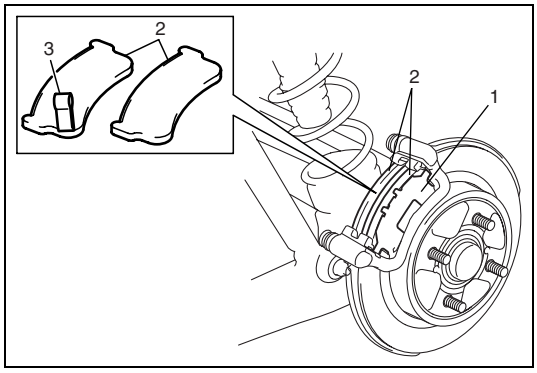
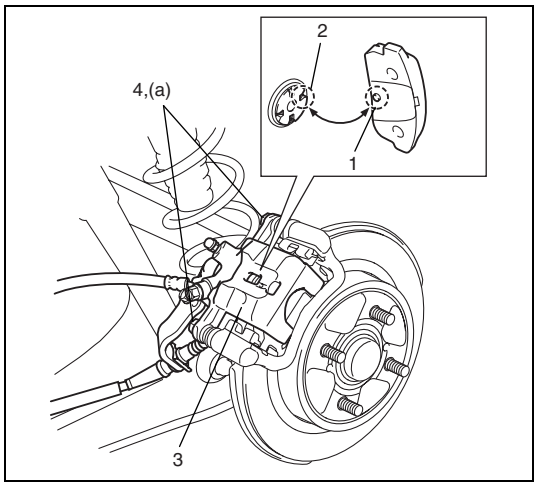


4) Set shim (1) and install brake pads (2).

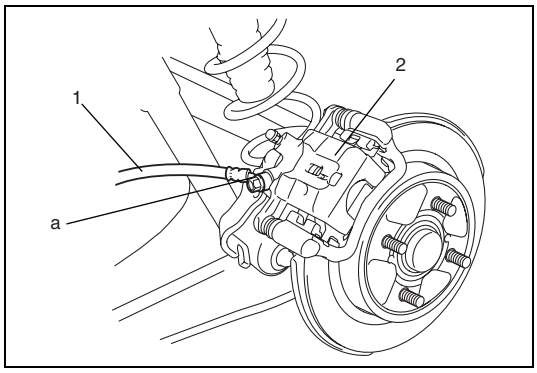
NOTE:

For right side brake, install pad with wear indicator (3) to vehicle center side.



5) With lug (1) of brake pad matched with dent (2) of brake piston, install caliper (3) to carrier.
Tighten caliper pin bolts (4) to specified torque.

Tightening torque
Caliper pin bolt (a): 27 N·m (2.7 kg-m, 19.5 lb-ft)



6) Connect flexible hose (1) to caliper (2).

WARNING:

Make sure that flexible hose is not twisted when tightening joint bolt. If it is twisted, reconnect it using care not to twist it.

Tightening torque
Flexible hose joint bolt (a): 23 N·m (2.3 kg-m, 17.0 lb-ft)

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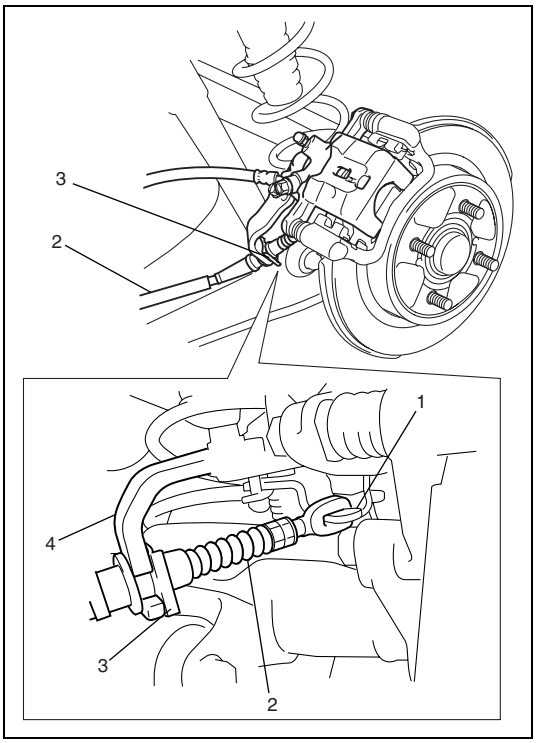
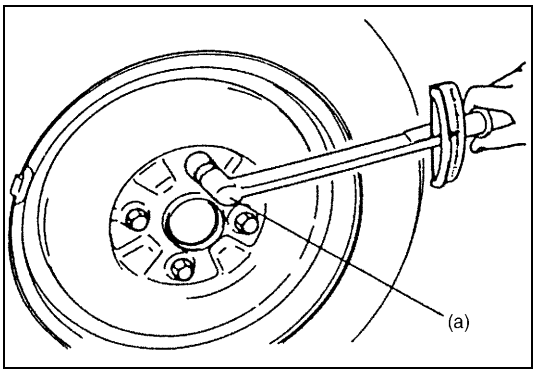


7) Connect parking brake cable (2) to lever (1) on caliper.
8) Install brake cable (2) and clip (3) securely to bracket (4).
9) After reassembling brake lines, bleed air from them referring to “Air Bleeding of Brake System” in this section.
10) Tighten wheel nuts temporarily and lower hoist.



11) Tighten wheel nuts to specified torque.

Tightening torque
Wheel nut (a): 85 N·m (8.5 kg-m, 61.5 lb-ft)

12) Upon completion of installing all parts, fill reservoir tank with specified fluid and bleed brake system of entrapped air.
13) Check to make sure that system is free from fluid leakage.
14) Depress brake pedal with about 300 N (30 kg, 66 lbs) load three to five times so as to obtain proper disc to pad clearance.
15) Check to ensure that brake drum is free from dragging and proper braking is obtained.
16) Check to make sure that parking brake lever stroke is as specified. If not, adjust.
17) Remove vehicle from hoist and perform brake test (foot brake and parking brake).

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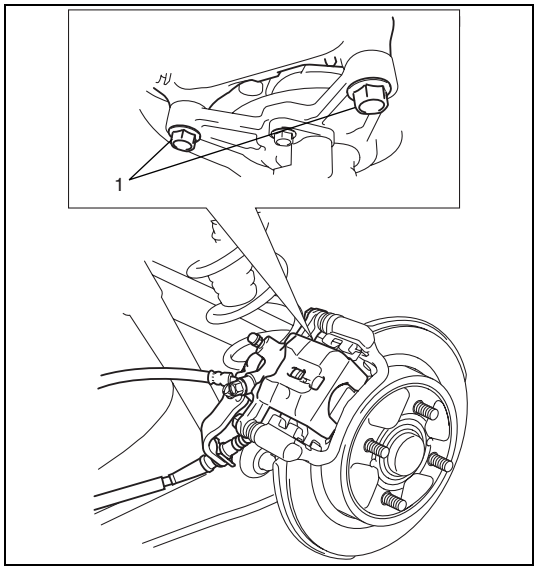
Rear brake disc

Removal

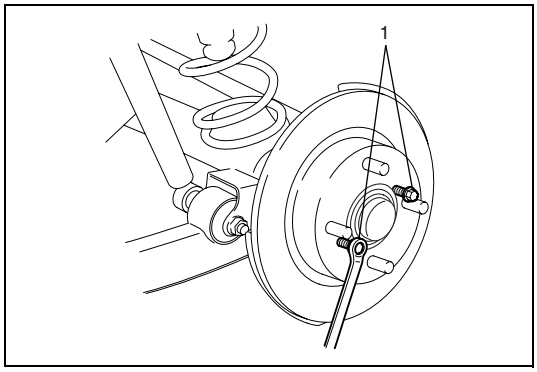
1) Hoist vehicle and remove wheel.



2) Remove caliper assembly by removing caliper carrier bolts (1) (2 pcs)

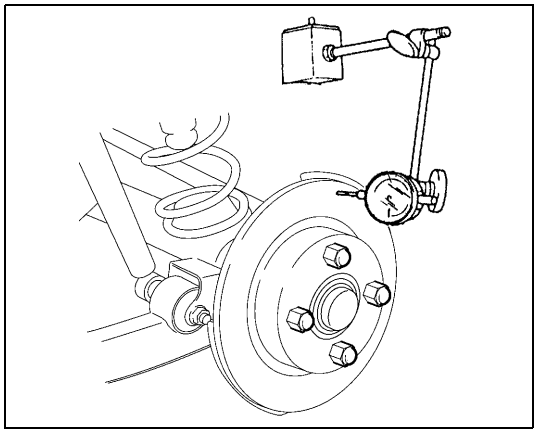
CAUTION:
During removal, be careful not to damage brake flexible hose and not to depress brake pedal.

NOTE:
Hang removed caliper with a wire hook or the like so as to prevent brake hose from bending and twisting excessively or being pulled.
Don't operate brake pedal with brake pads removed.



3) Pull brake disc off by using 8 mm bolts (1) (2 pcs).

Inspection



- Using magnetic stand and with dial gauge positioned at about 10 mm (0.39 in.) inward from periphery of disc, measure deflection of disc.
  If limit value is exceeded, replace correct or replace.

Disc deflection
Limit: 0.10 mm (0.004 in.) max.

Special tool
(A): 09900-20606
(B): 09900-20701

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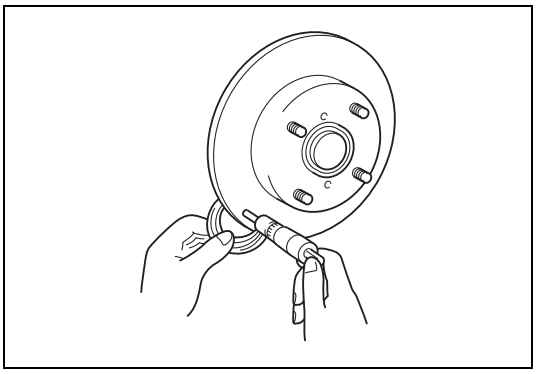
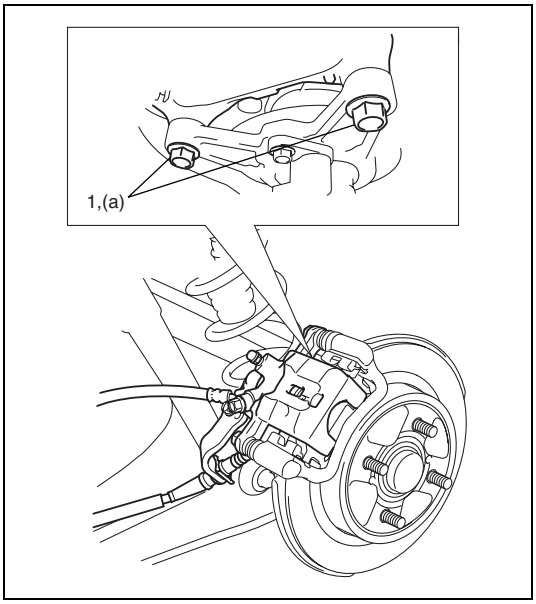


- Using micrometer, measure thickness of brake disc. If limit value is exceeded, replace brake disc.

Brake disc thickness
Standard: 9 mm (0.354 in.)
Limit: 8 mm (0.315 in.)

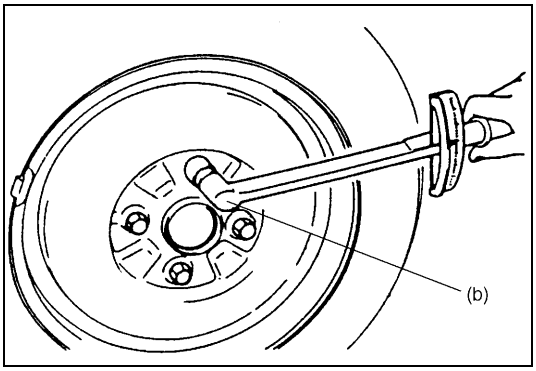
Installation

1) Install disc to wheel hub.
2) Install caliper assembly to rear axle.



3) Torque caliper carrier bolts (1) to specification.

Tightening torque
Caliper carrier bolt (a): 60 N·m (6.0 kg-m, 43.5 lb-ft)



4) Torque rear wheel nuts to specification.

Tightening torque
Wheel nut (b): 85 N·m (8.5 kg-m, 61.5 lb-ft)

5) Upon completion of installation, perform brake test.

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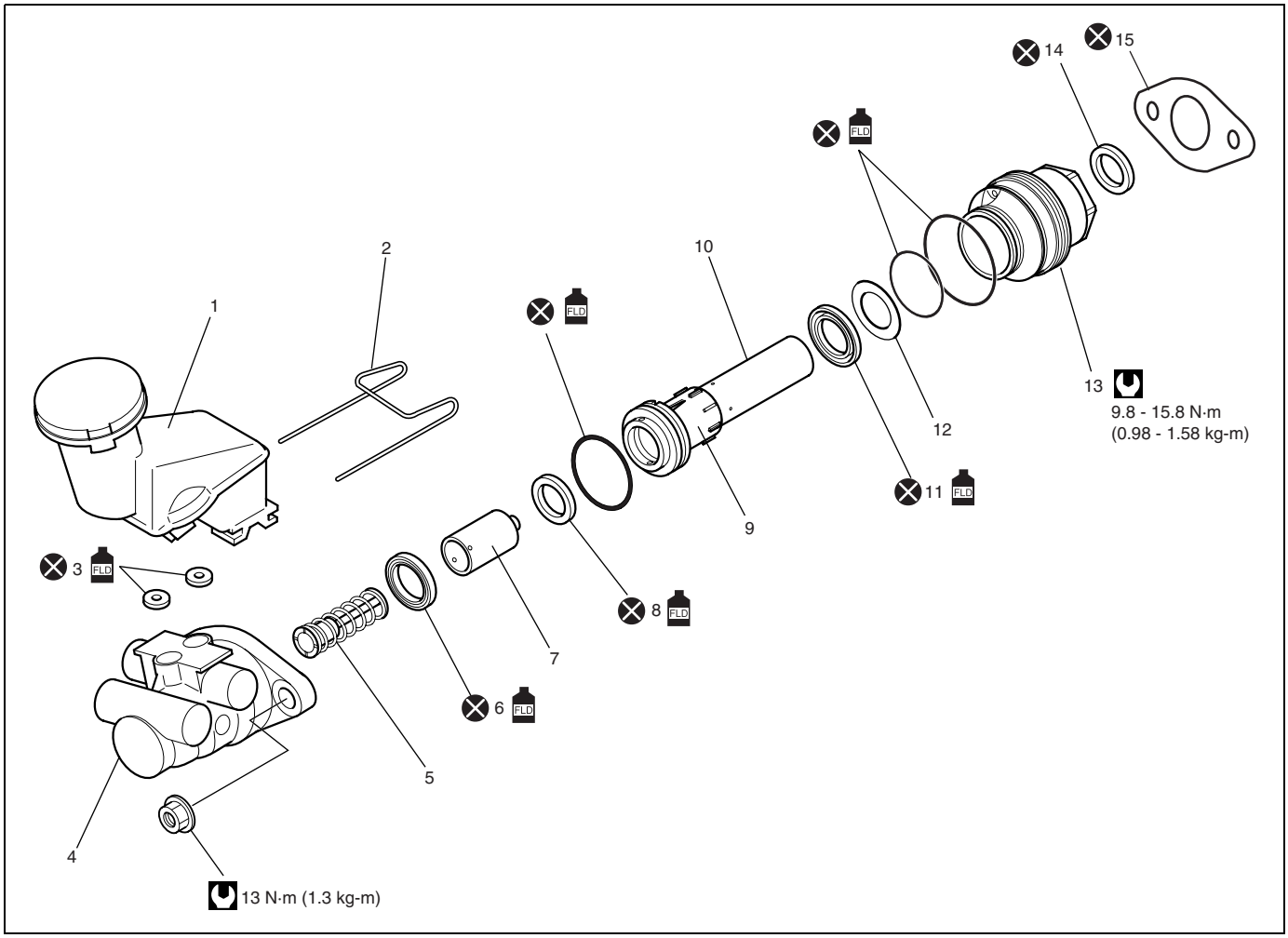
Master Cylinder (Sport Model)



1. Reservoir tank	8. Sleeve cup : Confirm installing direction.	15. Master cylinder gasket
2. Retainer	9. Sleeve	Tightening torque
3. Grommet : Apply brake fluid.	10. Primary piston : Apply brake fluid to contact surface of cup.	Do not reuse.
4. Master cylinder body	11. Primary cup : Confirm installing direction.	
5. Secondary return spring	12. Washer	
6. Secondary cup : Confirm installing direction Size of cup : 6=11>14>8 .	13. Cap	
7. Secondary piston : Apply brake fluid to contact surface of cup.	14. Cap cup : Confirm installing direction.	

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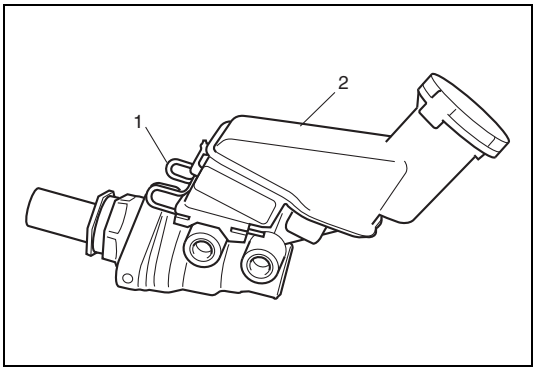
Master cylinder reservoir (sport model)

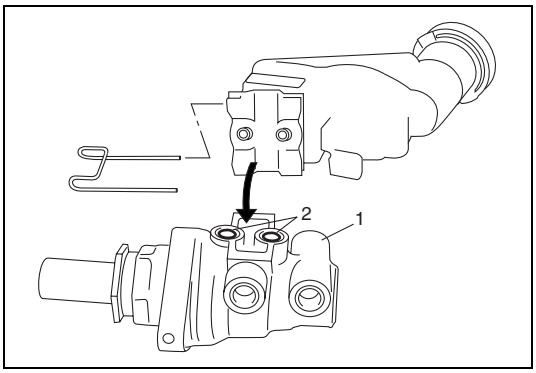
Removal

1) Remove master cylinder referring to “Removal” under “Master cylinder assembly” in this section.



2) Pull out retainer (1) and remove reservoir (2).
3) Remove grommets.

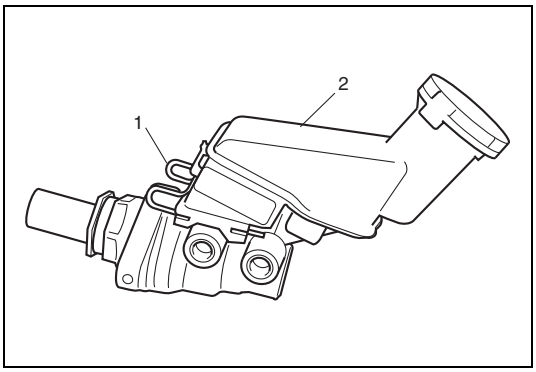
Installation



1) Apply brake fluid to new grommets and attach grommets (2) to master cylinder (1).

NOTE:

Be sure to use new grommets.



2) Install reservoir (2) to master cylinder and insert retainer (1).
3) Install master cylinder referring to “Installation” in “Master cylinder assembly (sport model)” in this section.
4) Fill reservoir with specified brake fluid up to its MAX mark.
5) After completing above work, bleed air and check brake pedal for play and brake fluid leakage.

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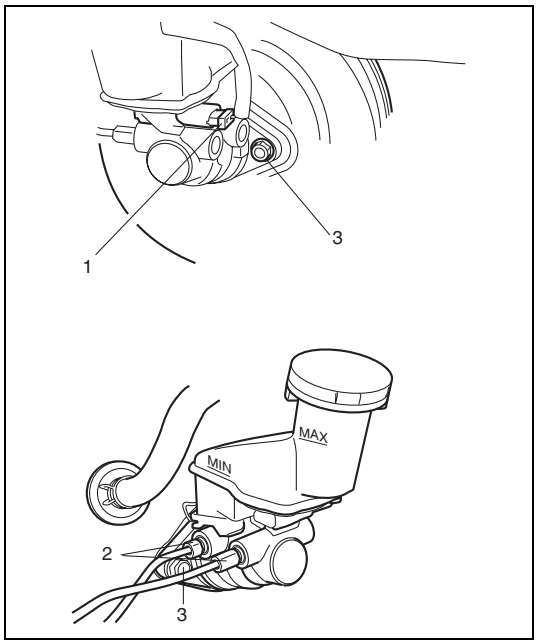
Master cylinder assembly (sport model)

Removal

1) Clean outside of master cylinder.
2) Drain brake fluid in reservoir.

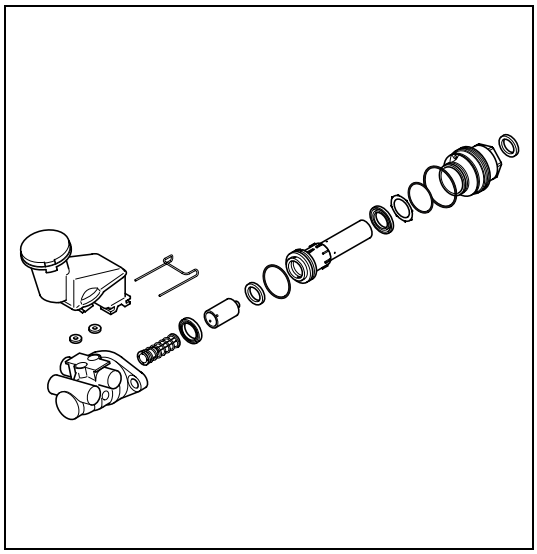


3) Disconnect fluid level switch coupler (1) on reservoir.
4) Disconnect brake pipes (2) connected to master cylinder.

CAUTION:
Do not allow brake fluid to get on painted surface. Painted surface will be damaged by brake fluid, flush it with water immediately if any fluid is spilled.

5) Remove master cylinder fixing nuts (3).
6) Remove master cylinder and master cylinder gasket.

Inspection



1) Check all disassembled parts for wear and damage.
   If anything faulty is found, replace.

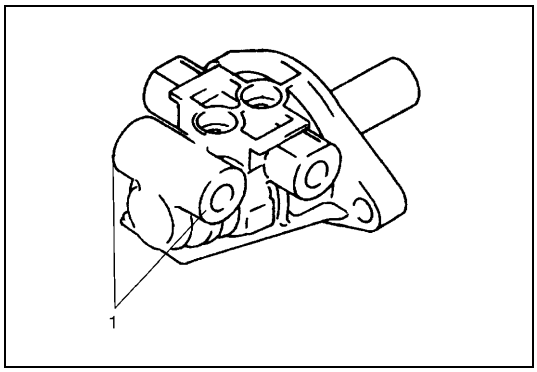
CAUTION:
- **Wash disassembled parts with brake fluid.**
- **Do not reuse piston cups and O-rings.**

2) Check screw hole in master cylinder for gall or corrosion.
   If anything faulty is found, replace.

CAUTION:
Wash master cylinder with new brake fluid. Do not use cloth to dry cylinder so as to avoid fibers being attached to internal surface of cylinder.

Disassembly

1) Loosen cap and remove it.



NOTE:
For this work, apply a cloth to outlet port at the tip end (1) of master cylinder body and secure cylinder using soft jawed vise.

2) Remove component parts from master cylinder body.

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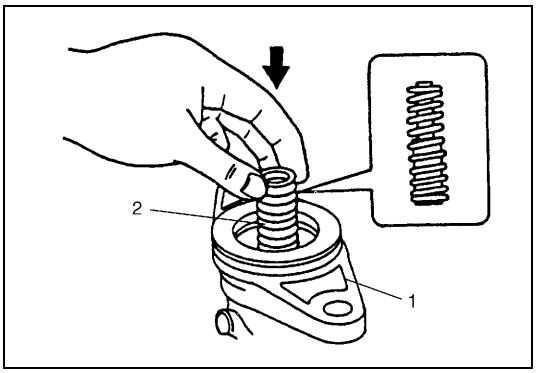
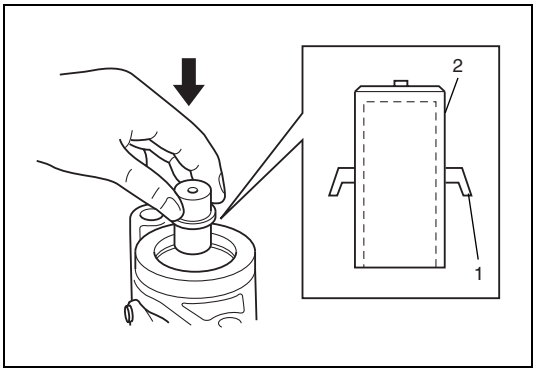
Assembly

CAUTION:
- **Never use any mineral oil such as kerosene oil and gasoline when washing and assembling parts.**
- **Check inside of cylinder wall, pistons and cup seals are free from any foreign objects such as dust and dirt and use case not to cause any damage with a tool during assembly.**
- **Do not drop parts. Do not use any part which has been dropped.**

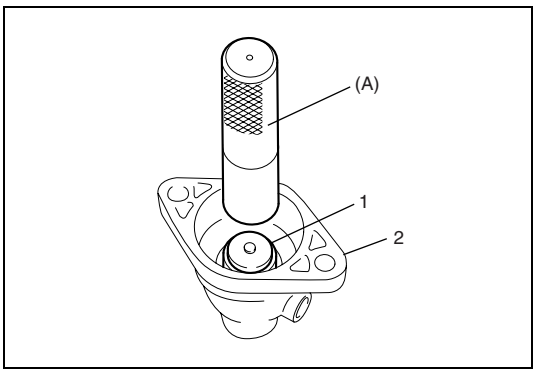


1) Apply brake fluid to inside of cylinder and contact surface of piston assembly.
   Install secondary return spring (2) to cylinder body (1) with noting spring direction.



2) Attach secondary cup (1) to secondary piston (2), they install it to cylinder body such a direction as shown.

NOTE:
- **Secondary cup is the same as primary cup.**
- **Diameter of secondary cup is the largest compared with sleeve cup and cap cup.**



3) Set master cylinder (2) and special tool (A) upright as shown. Then push secondary cup (1) to the bottom with special tool (A) using care not to tilt secondary cup (1).

Special tool
(A): 09913-80113

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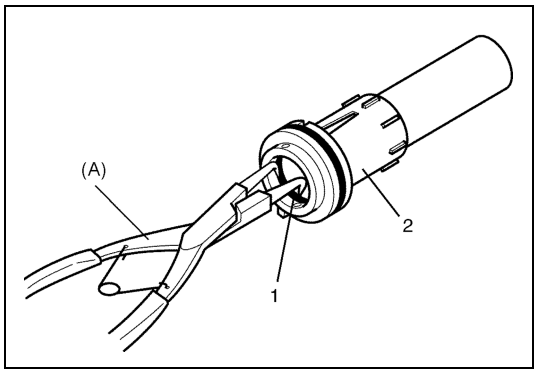
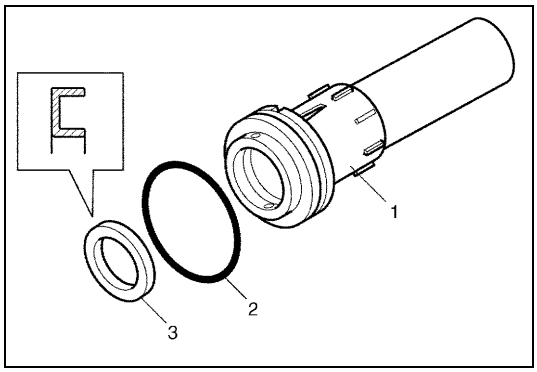


4) Remove sleeve cup (1) from sleeve (2).

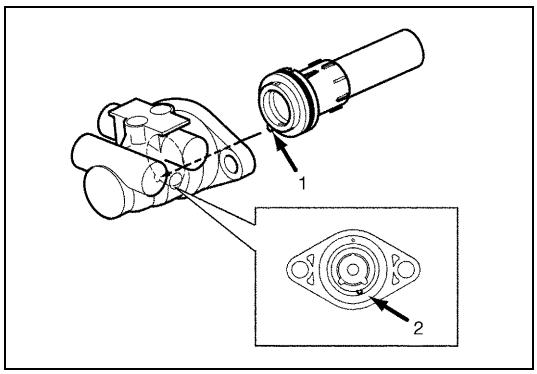
CAUTION:
Do not cause any damage to inside of sleeve.
If caused, replace primary piston assembly.

Special tool
(A): 09900-06106

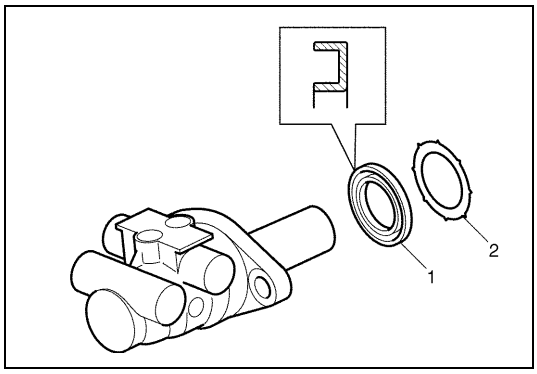


5) Install sleeve cup (3) and O-ring (2) to sleeve (1) such a direction as shown.

NOTE:
- **Diameter of sleeve cup and O-ring are smaller than those of cap.**
- **O-ring is the same as that of smaller one of cap O-ring.**

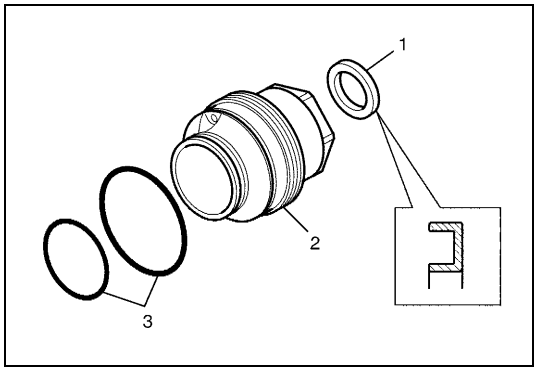


6) Install sleeve assembly with aligning protrusion (1) of sleeve and dent (2) of cylinder body.



7) Install cup (1) and washer (2) such a direction as shown.

NOTE:
- **Primary cup is the same as secondary cup.**
- **Primary cup is the largest compared with that of cap and sleeve.**



8) Remove cap cup (1) from cap with caring not to cause any damage to inside of cap (2).
9) Install cap cup and O-rings (3) to cap such a direction as shown.

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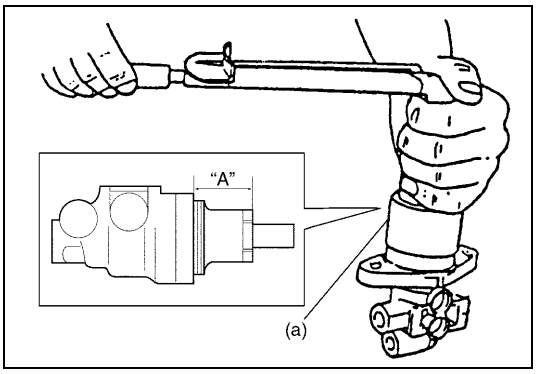
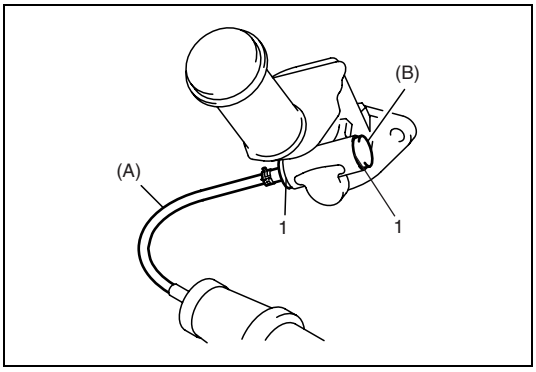


10) Install cap and tighten it to specified torque, then confirm the length "A".

Tightening torque
Cap (a): 9.8 – 15.8 N·m (0.98 – 1.58 kg-m, 7.1– 11.4 lb-ft)

Cap installation position
"A": Less than 26 mm (1.02 in.)

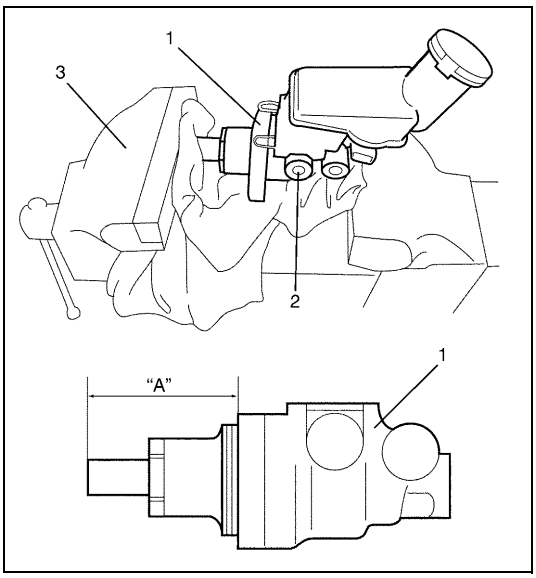
Inspection After Assembly



1) Install radiator cap test with special tool to master cylinder port (1).

Special tool
(A): 09952-46010
(B): 09952-26020

2) Apply air and confirm that pressure is not applied.



3) Set master cylinder (1) on vise (3) and adjust "A" to be the following.

Cap adjustment position
"A": 50 mm (1.97 in.)

4) Apply air with radiator cap tester, and confirm that 50 kPa pressure is applied.
5) Perform same steps 1) to 4) for port (2).

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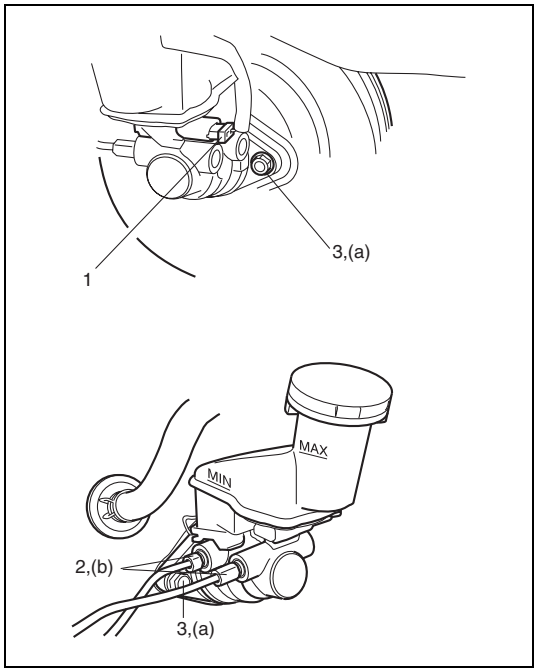


Installation

1) Install new master cylinder gasket to booster.
2) Install master cylinder to booster and tighten master cylinder fixing nuts (3) to specified torque.

Tightening torque
Master cylinder fixing nut (a): 13 N·m (1.3 kg-m, 9.5 lb-ft)

3) Connect brake pipe to master cylinder and tighten flare nut (2) to specified torque.

Tightening torque
Brake pipe flare nut (b): 16 N·m (1.6 kg-m, 11.5 lb-ft)

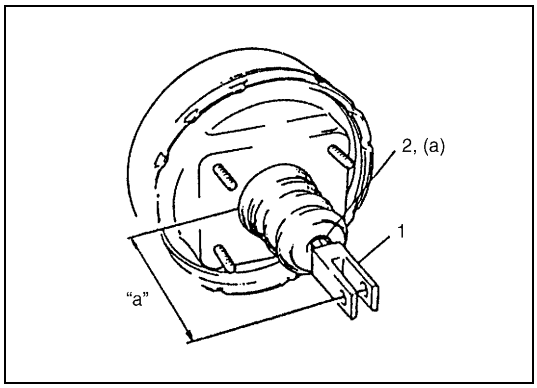
4) Connect fluid level switch connector (1) of reservoir.
5) Fill reservoir with specified brake fluid up to its MAX mark.
6) After completing above work, bleed air and check brake pedal for play.

Brake Booster

CAUTION:
Never disassemble brake booster. Disassembly will spoil its original function. If faulty condition is found, replace it with new one.

Inspection and Adjustment

Installation Position of Push Rod



If push rod clevis (1) has been removed, adjust distance between booster installation surface (without including packing) and the center of clevis pin hole to standard value "a" and tighten nut (2) to specified torque.

Distance "a" between center of booster clevis pin hole and booster surface
Standard: 97 – 98 mm (3.82 – 3.86 in.)

Tightening torque
Clevis pin lock nut (a): 19 N·m (1.9 kg-m, 14.0 lb-ft)

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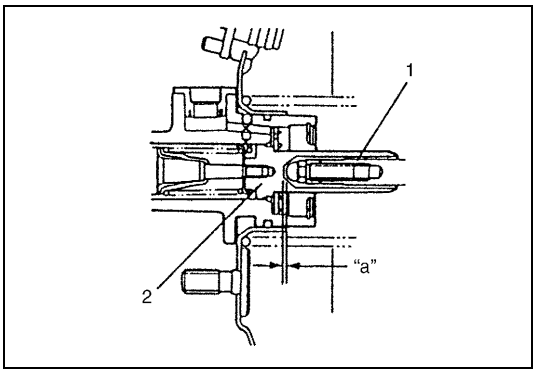
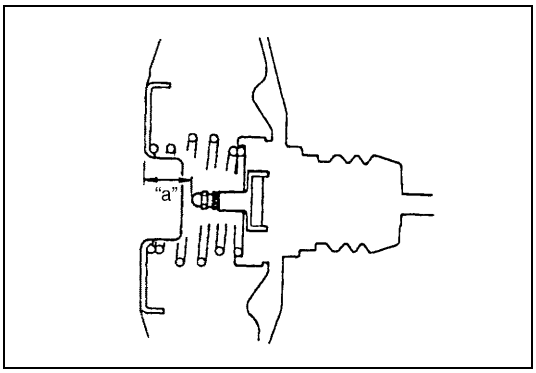
Clearance Between Booster Piston Rod and Master Cylinder Piston



The length of booster piston rod (1) is adjusted to provide specified clearance "a" between piston rod (1) end and master cylinder piston (2).

- Before measuring clearance, push piston rod several times so as to make sure reaction disc is in place.
- Keep inside of booster at atmospheric pressure for measurement.

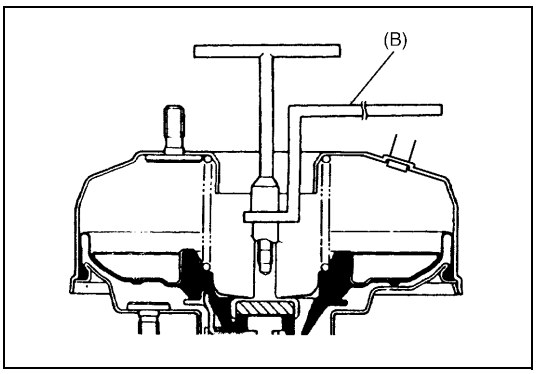


Measure length "a" of piston rod, i.e. distance between piston rod and mating surface of booster-to-master cylinder.

Length "a" of piston rod
: 30.3 – 30.5 mm (1.193 – 1.200 in.) ····· Except sport model
: 23.3 – 23.5 mm (0.917 – 0.925 in.) ····· Sport model

NOTE:

Remove gasket from booster, if equipped.



If measurement is out of specification, adjust piston rod by turning adjusting screw of piston rod.

Special tool
(B): 09952-16020

Brake Hose/Pipe

Rear brake hose/pipe

Removal

1) Raise and support vehicle properly. Remove tire and wheel.
2) Clean dirt and foreign material from both flexible hose end and pipe end fittings.
3) Remove brake flexible hose or pipe.

Installation

Reverse brake flexible hose installation procedure, nothing the followings.

- Fill and maintain brake fluid level in reservoir.
- Bleed brake system. Refer to "Air Bleeding of Brake System".
- Perform brake test and check each installed part for fluid leakage.
- Never reuse protector nut once removed. Be sure to use a new one.
- Install clamps properly referring to figure below and tighten bolts.
- When installing hose, make sure that it has no twist or kink.

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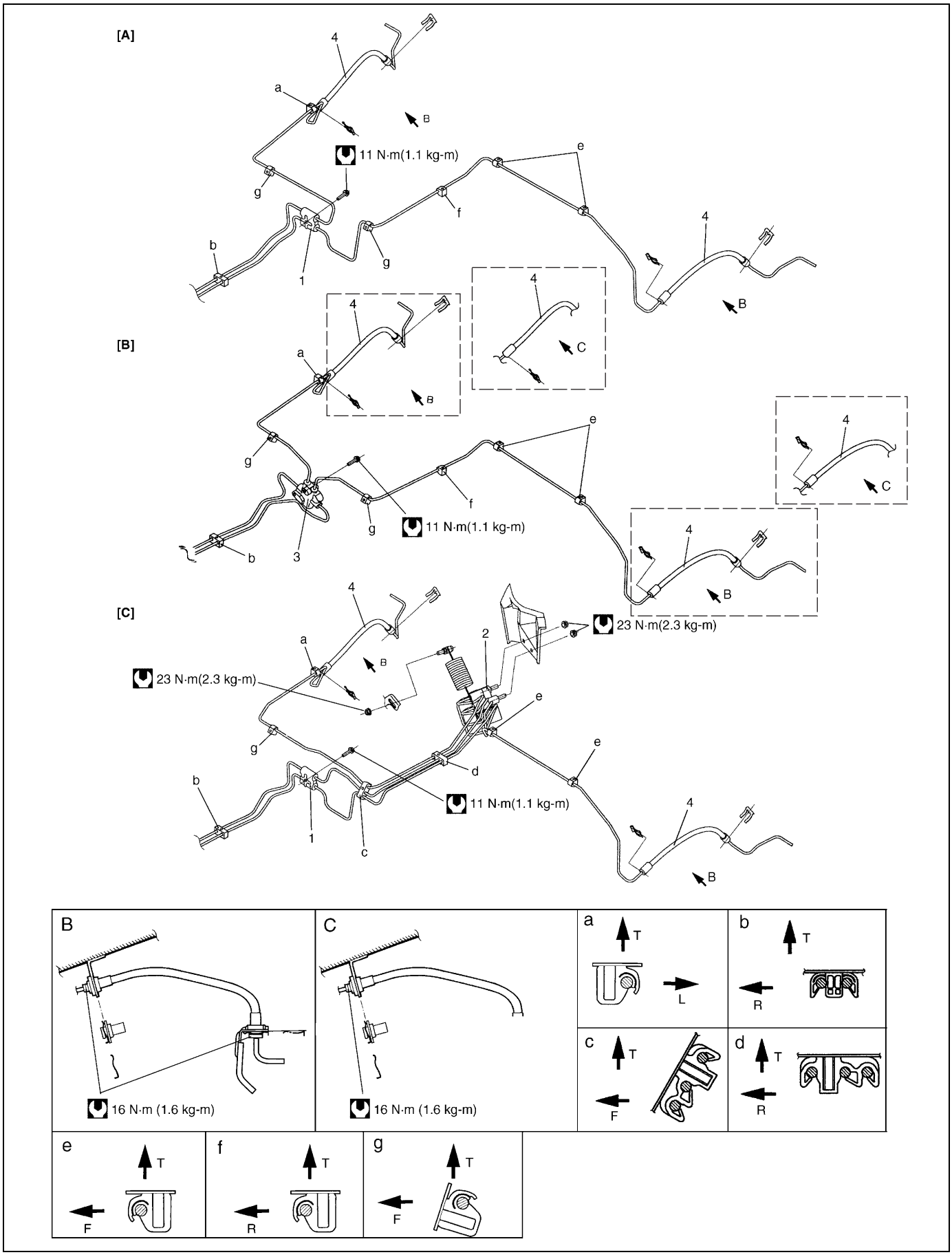

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T: Top side	C: View C (Sport model)	a – g: Clamp
F: Front side	1. 4 way joint	[A]: with ABS (if equipped)
R: Right side	2. LSPV assembly	[B]: with P (Proportioning) valve
L: Left side	3. P valve	[C]: with LSPV
B: View B	4. Rear brake hose	Tightening torque

Parking Brake

Parking brake cable (sport model)

Removal

1) Disconnect parking brake cable from rear brake caliper referring to “Removal” under “Rear Brake Caliper Assembly (Sport Model)” in this section.

NOTE:

When it is necessary to remove both right and left parking brake cables, repeat above Step 1) on right and left wheels.

2) Remove cable from parking brake lever referring to “Removal” of “Parking Brake Lever”.

Installation

1) Connect parking brake cable to parking brake lever referring to “Installation” under “Parking Brake Lever” in this section.
2) Connect parking brake cable to rear brake caliper referring to “Installation” under “Rear Brake Caliper Assembly (Sport Model)” in this section.
3) Upon completion of installation, adjust cable referring to “Adjustment” under “Parking Brake Inspection and Adjustment” in this section.

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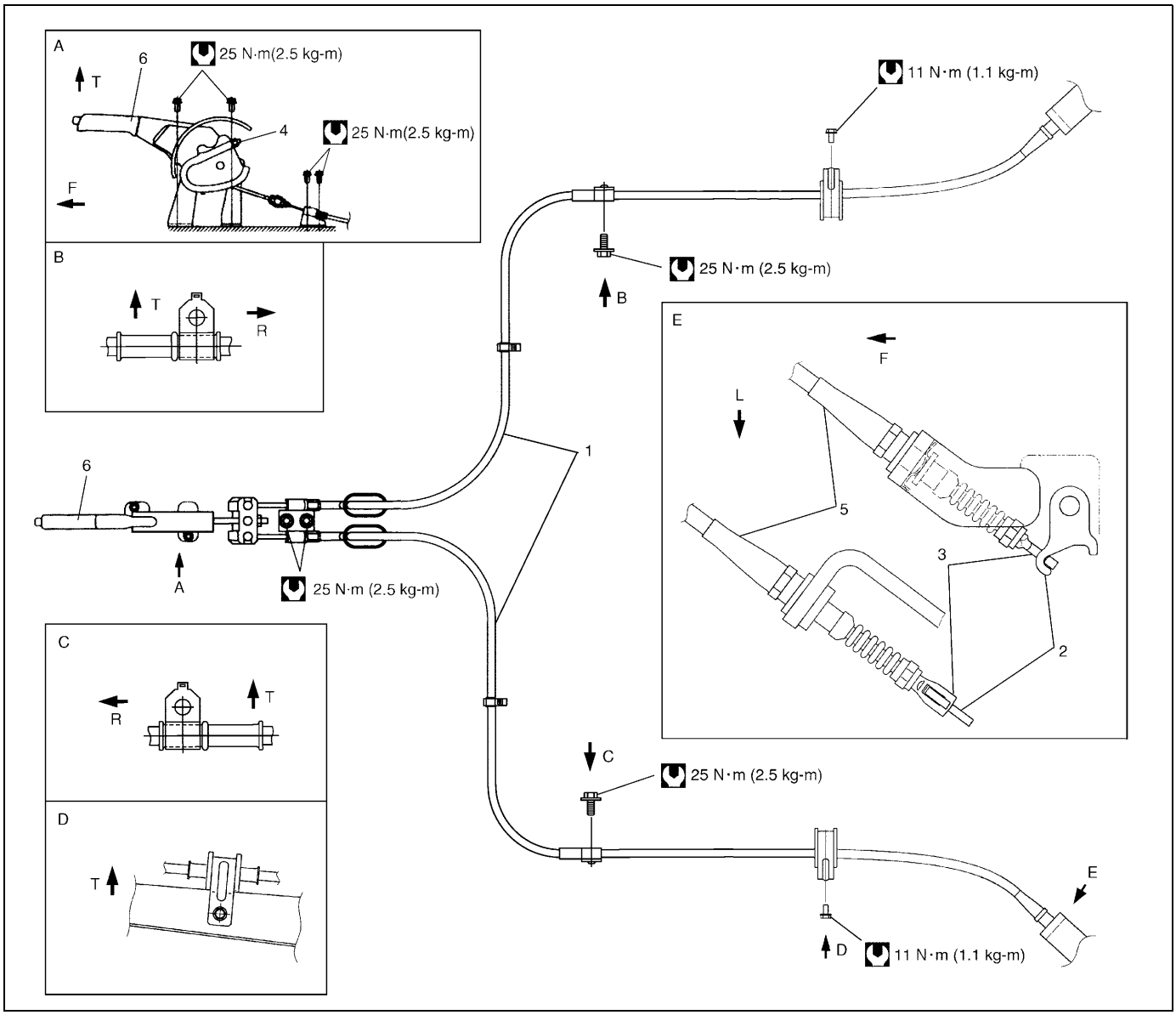

T: Top side	1. Cable	5. Clip
F: Front side	2. Parking brake lever	6. Parking brake lever
L: LH side	3. Inner cable end	Tightening torque
R: Rear side	4. Adjusting nut	

Parking brake cable (except sport model)

Removal

1) Remove brake drum. Refer to “Removal” under “Brake Drum” in this section.
2) Disconnect parking brake cable from brake shoe lever. Refer to “Removal” under “Brake Shoe” in this section.
3) Disconnect brake cable from brake back plate.

NOTE:

When it is necessary to remove both right and left parking brake cables, repeat above steps 1) and 2) on right and left wheels.

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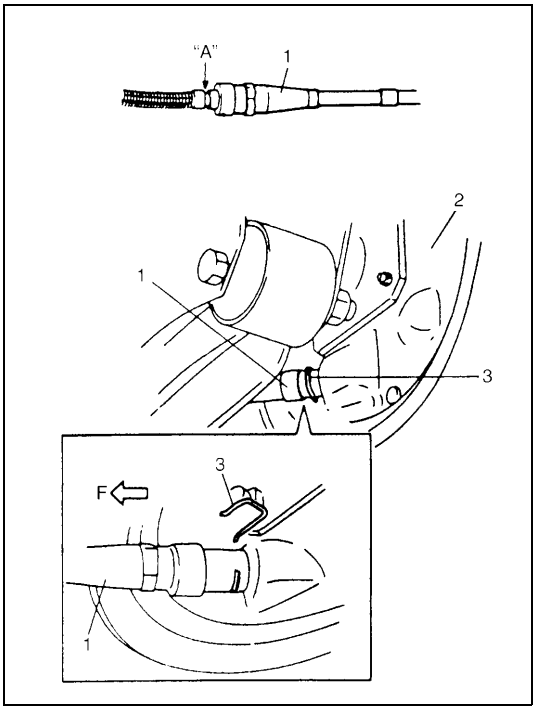
4) Remove cable from equalizer.

Installation

Install parts in reverse order of removal procedure, noting the following.



1) Distinguish right side parking brake cable from left side one with its clamp width.
   Parking brake cable with narrow clamp should be installed to right side of vehicle.
2) Apply water tight sealant where plate and cable contact, and run parking brake cable (1) through brake back plate (2) and secure it with clip (3).

"A": Sealant 366E, 99000-31090

F: Forward

3) Install clamps properly referring to "figure".
4) Tighten bolts and nuts to specified torque.
5) Adjust parking brake cable. (Refer to "Parking Brake Inspection and Adjustment".)
6) Check brake drum for dragging and brake system for proper performance. After removing vehicle from hoist, brake test should be performed.

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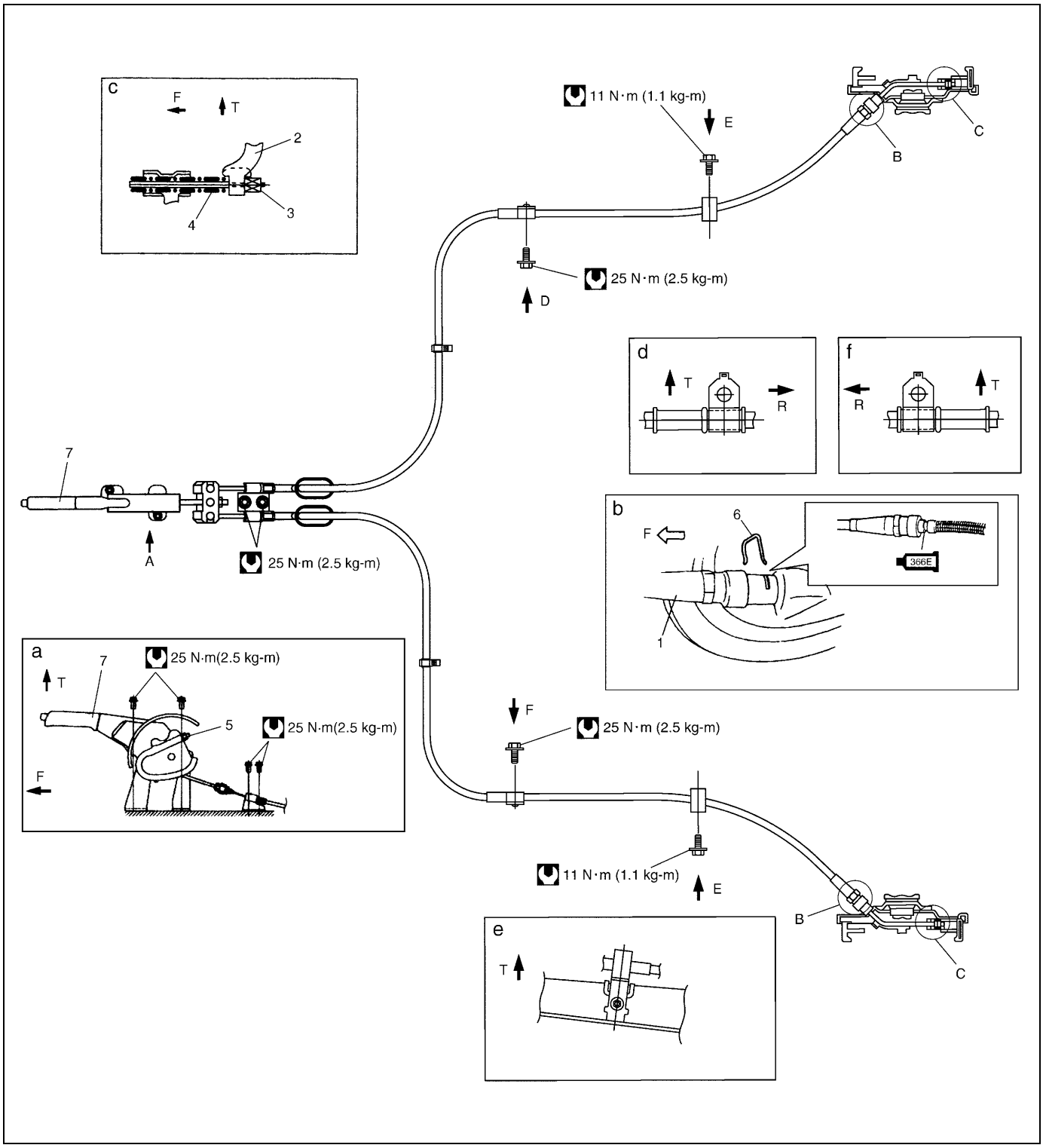

T: Top side	3. Inner cable end	a: View A	f: View F
F: Front side	4. Spring	b: View B	Tightening torque
R: Rear side	5. Adjusting nut	c: View C	
1. Cable : Apply water tight sealant (99000-31090)	6. Clip	d: View D	
2. Parking brake shoe lever	7. Parking brake lever	e: View E	

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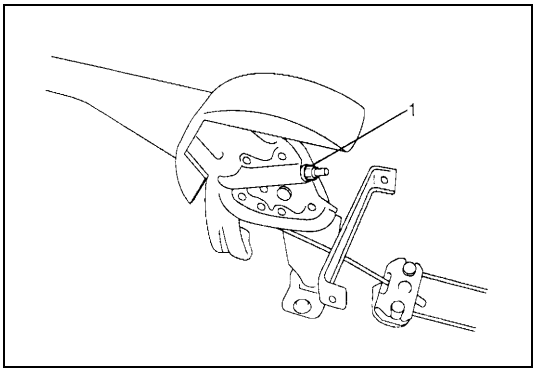
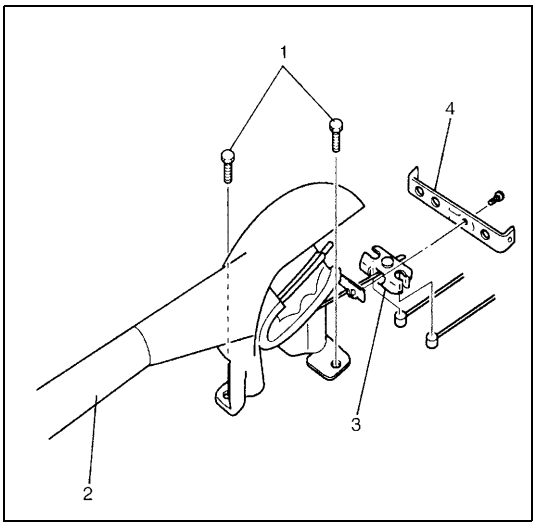
Parking brake lever

Removal



1) Disconnect negative (–) cable at battery.
2) Remove console box.
3) Block vehicle wheels and release parking brake lever.
4) Disconnect lead wire of parking brake switch at coupler.
5) Loosen parking brake cable adjusting nut (1).

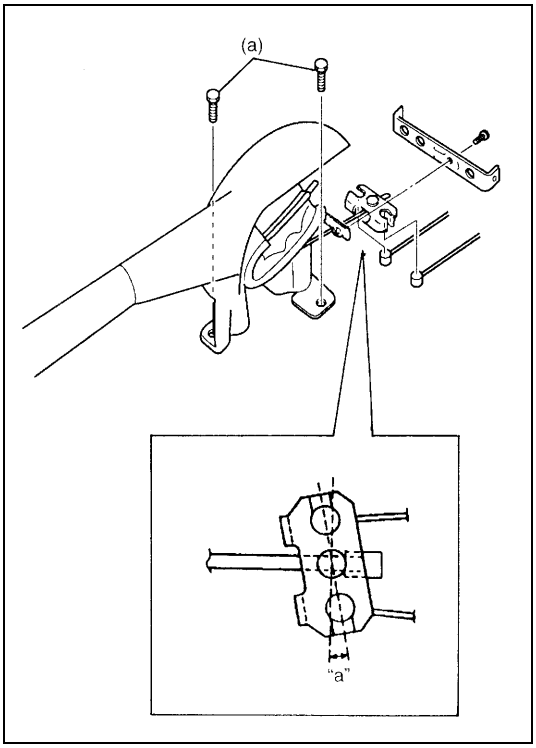


6) Remove parking brake lever bolts (1) and then remove parking brake lever assembly (2) with equalizer (3).
7) Remove console box bracket (4) from parking brake lever assembly.

NOTE:

Don't disassemble parking brake lever switch. It must be removed and installed as a complete switch assembly.

Installation



1) Install in reverse order of removal procedure.
   Check equalizer inclined angle.

Angle "a": within 15 degrees

Tightening torque
Parking brake lever mounting bolt
(a): 25 N·m (2.5 kg-m, 18.0 lb-ft)

2) After all parts are installed, parking brake lever needs to be adjusted. Refer to "Parking Brake Inspection and Adjustment" in Section 5.
3) Check brake drum for dragging and brake system for proper performance.

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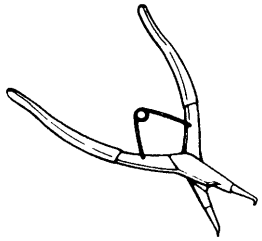
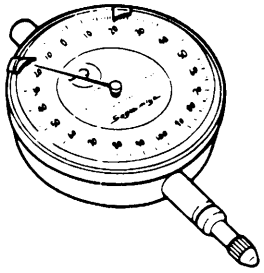
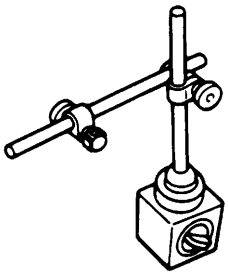
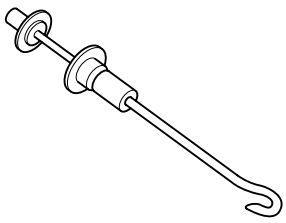
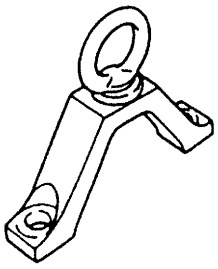
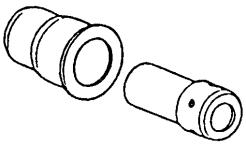
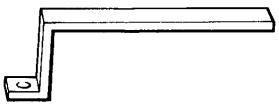
Required Service Material

Material	Recommended SUZUKI product (Part Number)	Use
Brake fluid	DOT 3	• To fill master cylinder reservoir. • To clean and apply to inner parts of master cylinder caliper and wheel cylinder when they are disassembled.
Water tight sealant	SEALING COMPOUND 366E (99000-31090)	• To apply to mating surfaces of brake back plate and rear axle (2WD vehicle) or rear axle housing (4WD vehicle). • To apply to mating surfaces of brake back plate and parking brake cable.
Rubber grease	Rubber grease should be the one whose viscosity is less affected by such low temperature as –40 °C (–40 °F).	• To apply to slide pin of brake caliper carrier.

Special Tool

 09900-06106 Snap ring remover	 09900-20607 Dial gauge	 09900-20701 Dial gauge chuck	 09942-15511 Sliding hammer
 09943-17912 Brake drum remover (Front wheel hub remover)	 09951-18220 Secondary cup installer set (Except sport model)	 09952-16021 Booster piston rod adjuster	 09952-46010 Master cylinder attachment

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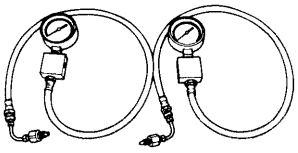
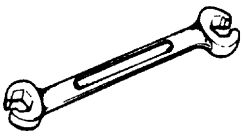
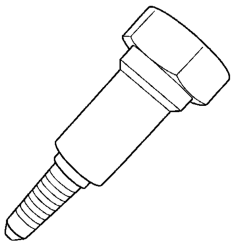
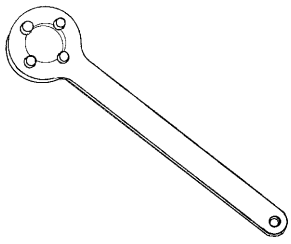
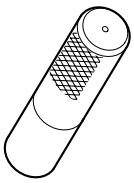
			
09952-26020 Master cylinder plug	09956-02311 Fluid pressure gauge	09950-78230 Flare nut wrench (10 x 11 mm)	09952-48320 Pressure gauge attachment
			
09945-16060 Piston installer (if equipped rear brake caliper)	09913-80113 Secondary cup installer (Sport model)		

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SECTION 5E

ANTILOCK BRAKE SYSTEM (ABS)

WARNING:

For vehicles equipped with Supplemental Restraint (Air Bag) System :

- **Service on and around the air bag system components or wiring must be performed only by an authorized SUZUKI dealer. Refer to "Air Bag System Components and Wiring Location View" under "General Description" in air bag system section in order to confirm whether you are performing service on or near the air bag system components or wiring. Please observe all WARNINGS and "Service Precautions" under "On-Vehicle Service" in air bag system section before performing service on or around the air bag system components or wiring. Failure to follow WARNINGS could result in unintentional activation of the system or could render the system inoperative. Either of these two conditions may result in severe injury.**
- **Technical service work must be started at least 90 seconds after the ignition switch is turned to the "LOCK" position and the negative cable is disconnected from the battery. Otherwise, the system may be activated by reserve energy in the Sensing and Diagnostic Module (SDM).**

NOTE:

- **All brake fasteners are important attaching parts in that they could affect the performance of vital parts and systems, and/or could result in major repair expense. They must be replaced with one of same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of all parts. There is to be no welding as it may result in extensive damage and weakening of the metal.**
- **For the items with asterisk (*) in the "CONTENTS" below, refer to the same section of the Service Manual mentioned in "FOREWORD" of this Manual.**

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DTC C1025 (DTC 25), DTC C1026 (DTC 26) – Left-front Wheel Speed Sensor Circuit or Sensor Ring ..... *
DTC C1031 (DTC 31), DTC C1032 (DTC 32) – Right-rear Wheel Speed Sensor Circuit or Sensor Ring ..... *
DTC C1035 (DTC 35), DTC C1036 (DTC 36) – Left-rear Wheel Speed Sensor Circuit or Sensor Ring ..... *
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DTC C1057 (DTC 57) – Power Source Circuit ..... *
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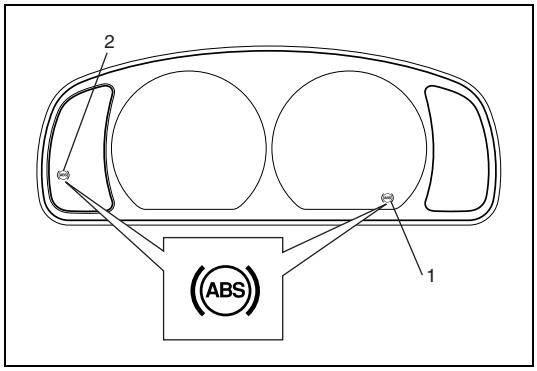
General Description

ABS Hydraulic Unit/Control Module Assembly

ABS control module is a component of ABS hydraulic unit/control module assembly and has the following functions.

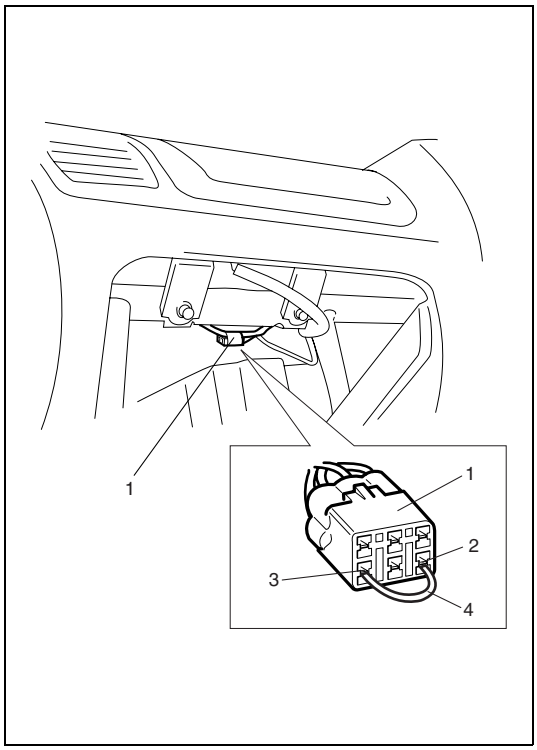
Self-diagnosis function



ABS control module diagnoses conditions of the system component parts (whether or not there is any abnormality) all the time and indicates the results (warning of abnormality occurrence and DTC) through the ABS warning lamp as described below.

1. Except sport model
2. Sport model

1) When ignition switch is turned ON, ABS warning lamp lights for 2 seconds to check its bulb and circuit.
2) When no abnormality has been detected (the system is in good condition), ABS warning lamp turns OFF after 2 seconds.
3) When an abnormality in the system is detected, ABS warning lamp lights and the area where that abnormality lies is stored in the memory of EEPROM in ABS control module.



4) When Diag. switch terminal (2) of diagnosis connector (1) (monitor connector) is grounded, the abnormal area is output as DTC. It is indicated by flashing of ABS warning lamp. (Refer to the table below.)

SYSTEM CONDITION		ABS WARNING LAMP	
		Diag. switch terminal is not grounded	Diag. switch terminal is grounded
In good condition at present	No trouble in the past	OFF	DTC 12
	Trouble occurred in the past	OFF	History DTC
Abnormality exists at present	No trouble in the past	ON	Current DTC
	Trouble occurred in the past	ON	Current and history DTCs

5) For procedure to clear all DTC's, refer to "Diagnostic Trouble Code Clearance" in this section.

3. Ground terminal
4. Service wire

Also ABS control module turns ON EBD warning lamp (brake warning lamp) depending on the trouble that detected by the module and EBD warning lamp does not indicate DTC as well as ABS warning lamp.

Fail-safe function

When an abnormality occurs (an abnormal DTC is detected), ABS control module turns OFF the fail-safe relay which supplies power to ABS hydraulic unit. Thus, with ABS not operating, brakes function just like the brake system of the vehicle without ABS.

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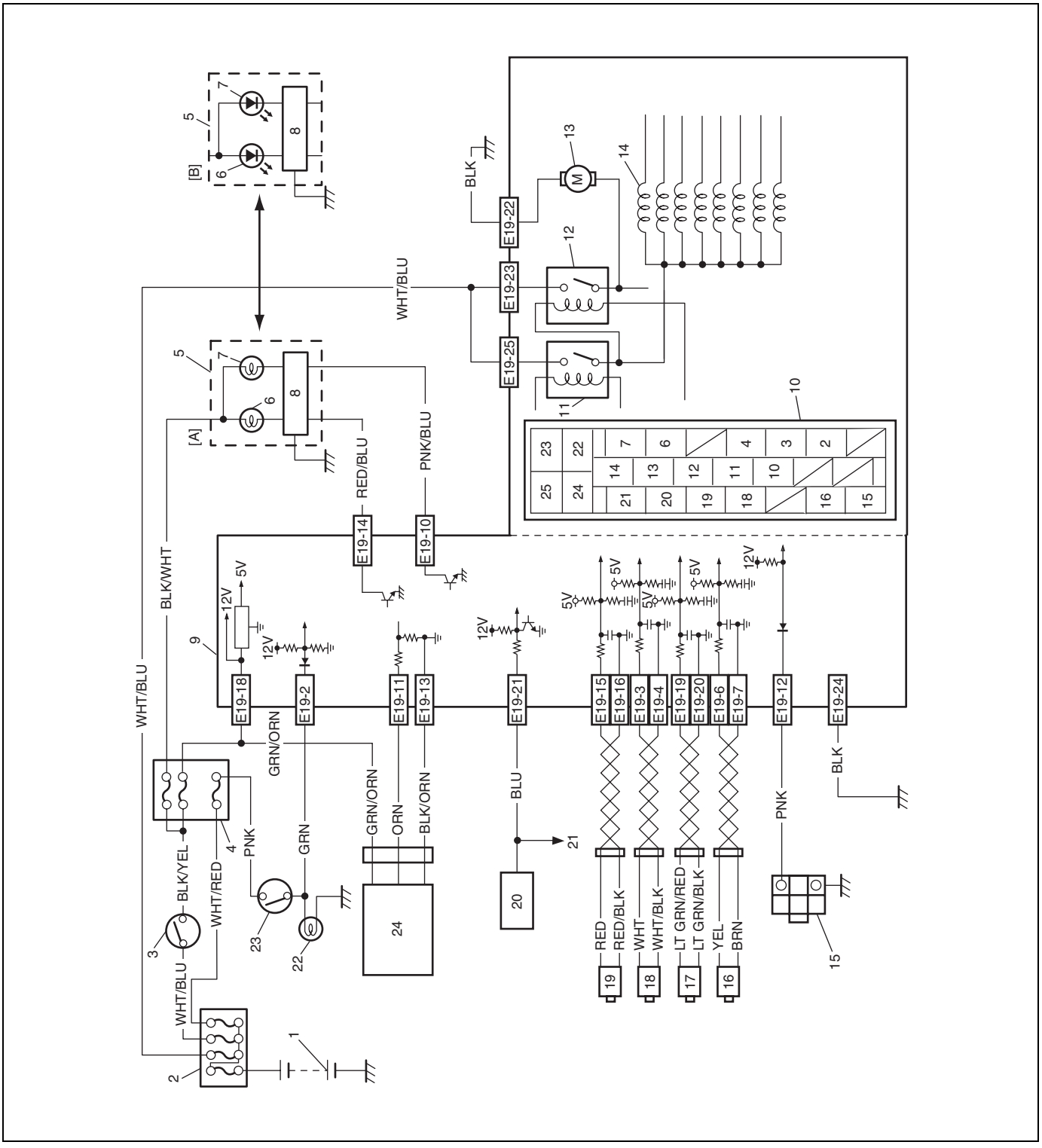
System Circuit



[A]: Except sport model	9. ABS hydraulic unit/control module assembly	19. Left-front wheel speed sensor
[B]: Sport model	10. Terminal arrangement of connector E19 for ABS hydraulic unit/control module assembly	20. Data link connector
1. Battery	11. ABS fail-safe relay (Solenoid valve relay)	21. To ECM, SDM and EPS controller (if equipped)
2. Main fuses	12. ABS pump motor relay	22. Stop lamp
3. Ignition switch	13. Pump motor	23. Stop lamp switch
4. Circuit fuses	14. Solenoid valves	24. G sensor (For 4WD vehicle only)
5. Combination meter	15. Diagnosis monitor coupler	
6. ABS warning lamp	16. Right-rear wheel speed sensor	
7. Brake warning lamp (“EBD” warning lamp)	17. Left-rear wheel speed sensor	
8. Warning lamp driver module (for ABS)	18. Right-front wheel speed sensor	

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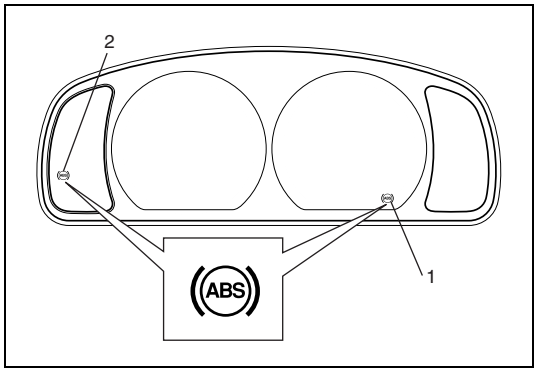
TERMINAL		CIRCUIT
E19	1	–
	2	Stop lamp switch
	3	Right-front wheel speed sensor (+)
	4	Right-front wheel speed sensor (–)
	5	–
	6	Right-rear wheel speed sensor (–)
	7	Right-rear wheel speed sensor (+)
	8	–
	9	–
	10	Brake warning lamp (EBD warning lamp)
	11	G sensor (For 4WD vehicle only)
	12	Diagnosis switch terminal
	13	Ground (For G sensor) (For 4WD vehicle only)
	14	ABS warning lamp
	15	Left-front wheel speed sensor (+)
	16	Left-front wheel speed sensor (–)
	17	–
	18	Ignition switch
	19	Left-rear wheel speed sensor (+)
	20	Left-rear wheel speed sensor (–)
	21	Data link connector
	22	Ground (for ABS pump motor)
	23	ABS pump motor relay
	24	Ground (for ABS control module)
	25	ABS fail-safe relay

Diagnosis

ABS Warning Lamp Check



1) Turn ignition switch ON.
2) Check that ABS warning lamp (1) comes ON for about 2 seconds and then goes off.
   If any faulty condition is found, advance to Diagnostic Flow Table-A, B, C or D.

1. Except sport model
2. Sport model

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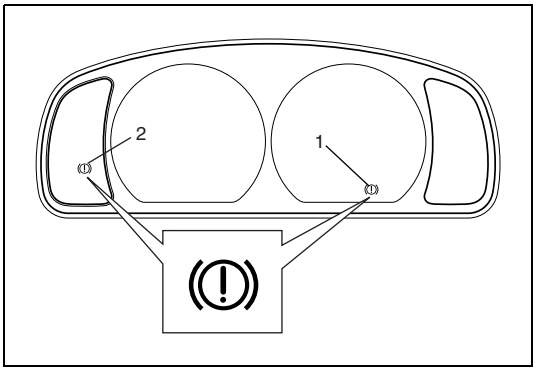
EBD Warning Lamp (Brake Warning Lamp) Check



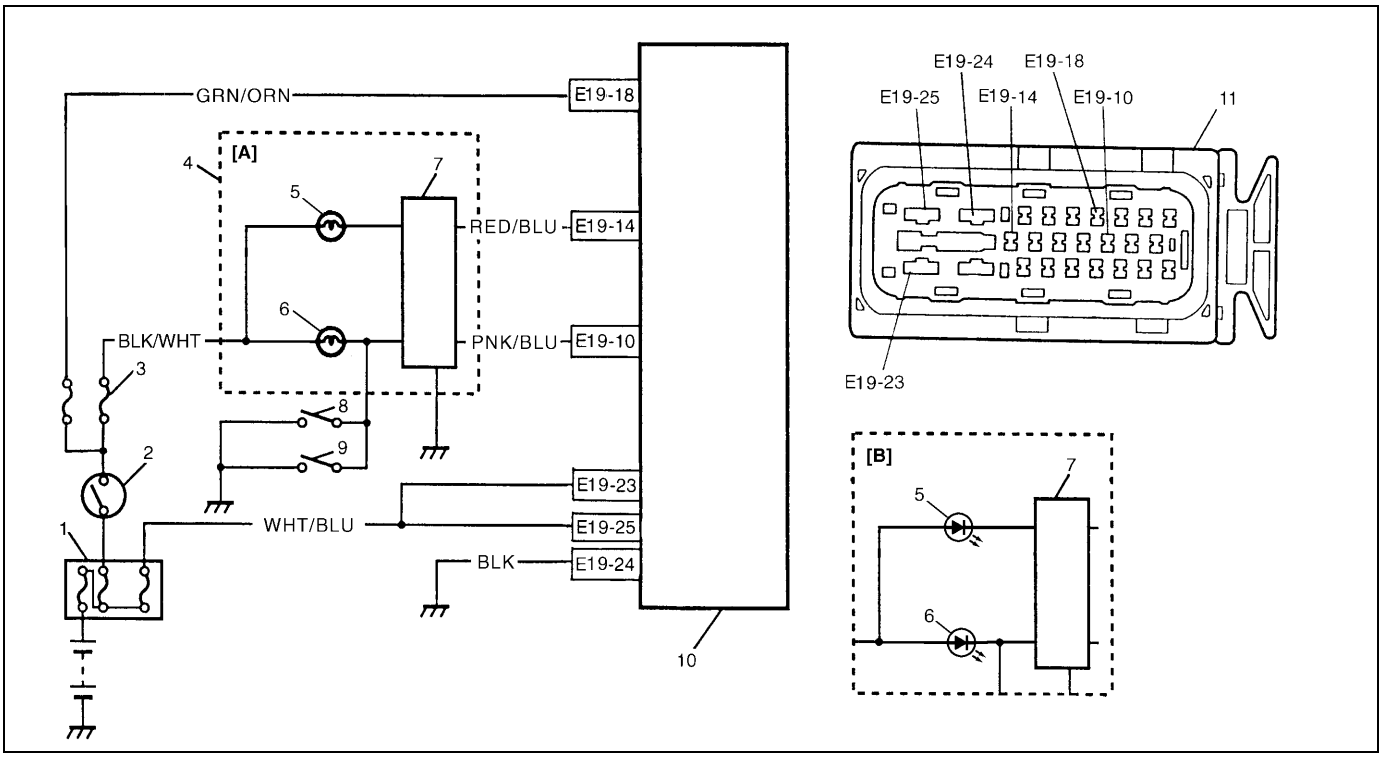
NOTE:

Perform this check on a level place.

1) Turn ignition switch ON with parking brake applied.
2) Check that EBD warning lamp (brake warning lamp) (1) is turned ON.
3) Release parking brake with ignition switch ON and check that EBD warning lamp (brake warning lamp) goes off.
   If it doesn't go off, go to "Table-E" in this section.

1.	Except sport model
2.	Sport model

Table – A ABS Warning Lamp Circuit Check – Lamp Does Not Come "ON" at Ignition Switch ON



[A]: Except sport model	4. Combination meter	9. Brake fluid level switch
[B]: Sport model	5. ABS warning lamp	10. ABS hydraulic unit/control module assembly
1. Main fuse	6. Brake warning lamp	11. ABS hydraulic unit/control module connector
2. Ignition switch	7. Lamp driver module	
3. Circuit fuse	8. Parking brake switch	

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Circuit Description

Operation (ON/OFF) of ABS warning lamp is controlled by ABS control module through lamp driver module in combination meter.
If the Antilock brake system is in good condition, ABS control module turns ABS warning lamp ON at the ignition switch ON, keeps it ON for 2 seconds and then turns it OFF. If an abnormality in the system is detected, ABS warning lamp is turned ON continuously by ABS control module. Also, it is turned ON continuously by lamp driver module when the connector of ABS control module is disconnected.

Inspection

Step	Action	Yes	No
1	1) Turn ignition switch ON. Do other warning lamp come ON?	Go to Step 2.	Go to Step 4.
2	1) Disconnect ABS hydraulic unit/control module connector. Does ABS warning lamp light with ignition switch ON?	Substitute a known-good ABS hydraulic unit/control module assembly and recheck.	Go to Step 3.
3	1) Remove combination meter with ignition switch turned OFF. 2) Check for proper connection to “RED/BLU” wire of 13 pin combination meter connector. 3) If OK, measure resistance between “RED/BLU” wire of 13 pin combination meter connector and vehicle body ground. Is it infinite (∞)?	Go to Step 6.	“RED/BLU” wire circuit shorted to ground.
4	Is “METER” fuse in good condition?	Go to Step 5.	Replace “METER” fuse and check for short.
5	1) Check for proper connection to “BLK/WHT” wire of 16 pin combination meter connector. 2) If OK, measure resistance between “BLK/WHT” wire of 16 pin combination meter connector and vehicle body ground with ignition switch turned ON. Is it 10 – 14 V?	Go to Step 6.	“BLK/WHT” wire circuit open.
6	1) Measure resistance between “BLK” wire of 13 pin combination meter connector and vehicle body ground. Is resistance below 5 Ω?	[Except sport model] Check ABS warning lamp bulb. If OK, replace combination meter. [Sport model] Replace combination meter.	“BLK” wire circuit open or high resistance.

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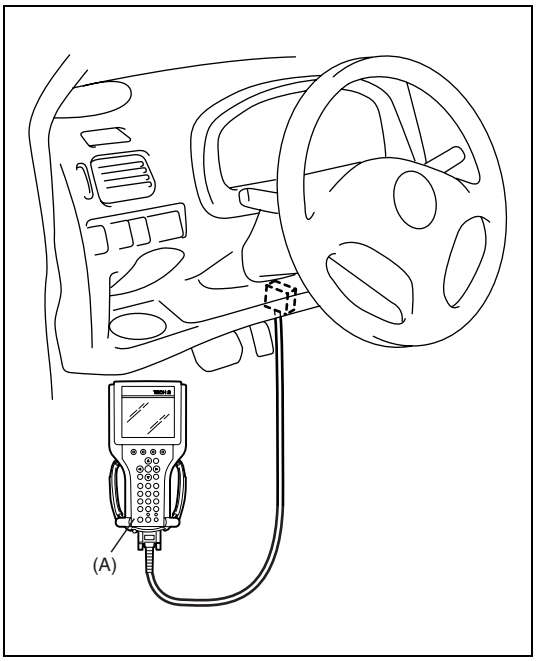
Diagnostic Trouble Code (DTC) Check (Using SUZUKI Scan Tool)



1) Turn ignition switch to OFF position.
2) Connect SUZUKI scan tool to data link connector.

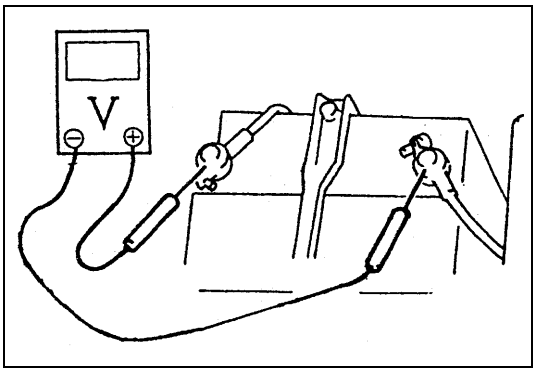
Special tool
(A): SUZUKI scan tool

3) Turn ignition switch ON.
4) Read DTC according to instructions displayed on SUZUKI scan tool and print it or write it down. Refer to SUZUKI scan tool operator's manual for further details.
5) After completing the check, turn ignition switch off and disconnect SUZUKI scan tool from DLC.
   If communication between SUZUKI scan tool and ABS hydraulic unit/control module is not possible, check if SUZUKI scan tool is communicable by connecting it to ABS case, SUZUKI scan tool is in good condition. Then check data link connector and serial data line (circuit) in the vehicle with which communication was not possible.

On-Vehicle Service

ABS Hydraulic Unit Operation Check (Using SUZUKI Scan Tool)

1) Check that basic brake system other than ABS is in good condition.



2) Check that battery voltage is 11 V or higher.
3) With ABS warning lamp, check that no abnormality is detected in ABS. Refer to "Diagnostic Trouble Code (DTC) Check" in this section.
4) Lift up vehicle.
5) Set transmission to neutral and release parking brake.
6) Turn each wheel gradually by hand to check if brake dragging occurs. If it does, correct.

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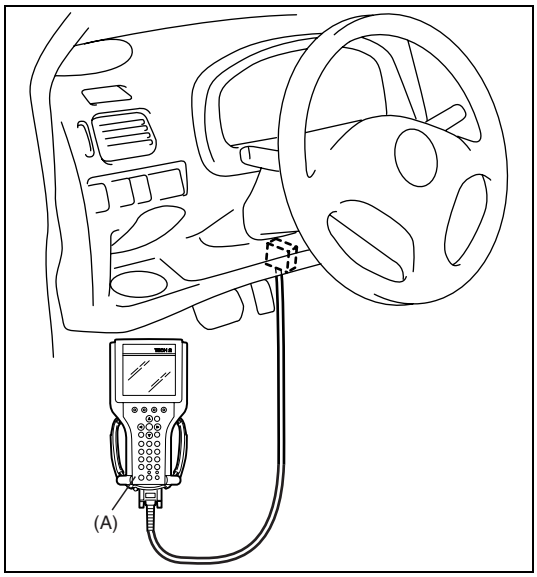


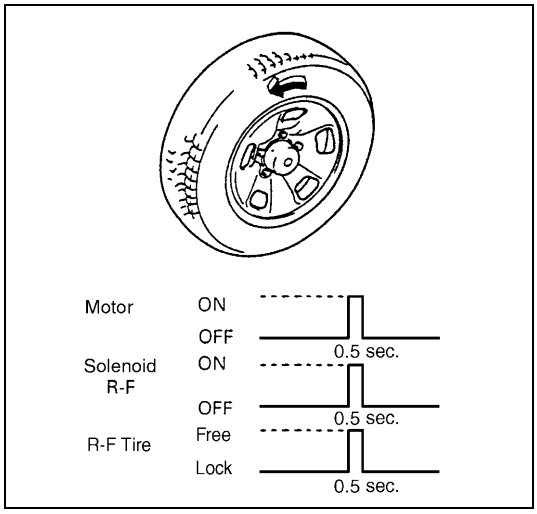
7) Connect SUZUKI scan tool to data link connector (DLC) with ignition switch turned OFF.

Special tool
(A): SUZUKI scan tool

8) Turn ignition switch to ON position and check actuator operation using “Hydraulic Control Test” under “Miscellaneous Test” (“MISC. Test”) mode of SUZUKI scan tool. Follow the instructions indicated on the SUZUKI scan tool.

NOTE:

For further details, refer to the operator’s manual for SUZUKI scan tool.

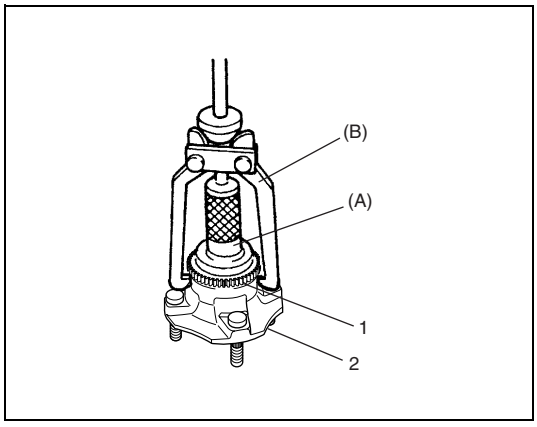


9) Check that each wheel turns when only brake force is depressurized (about 0.5 sec.)
10) If a faulty condition is found in Steps 9), replace hydraulic unit/control module assembly.
11) Turn ignition switch OFF and disconnect SUZUKI scan tool from data link connector (DLC).

Rear Wheel Speed Sensor Ring (Sport Model)

Removal

1) Remove rear wheel sensor from rear axle housing.
2) Remove rear brake disc referring to “Rear Brake Disc” in Section 5.
3) Remove rear wheel hub referring to “Wheel Bearing and Wheel Stud (For Sport Model)” in Section 3F.



4) Remove sensor ring (1) from rear wheel hub (2) using special tools.

Special tool
(A) : 09913-75520
(B) : 09913-65135

CAUTION:

Pull out sensor ring from rear wheel hub gradually and evenly. Attempt to pull it out partially may cause it to be deformed.

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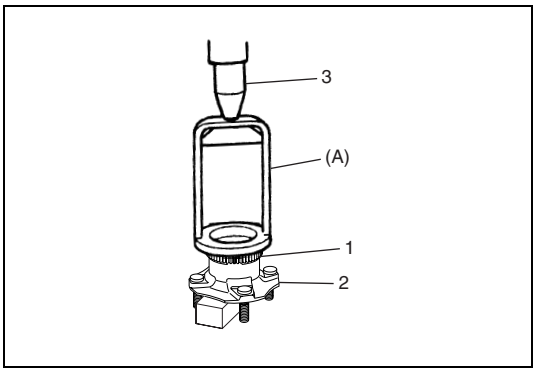
Installation

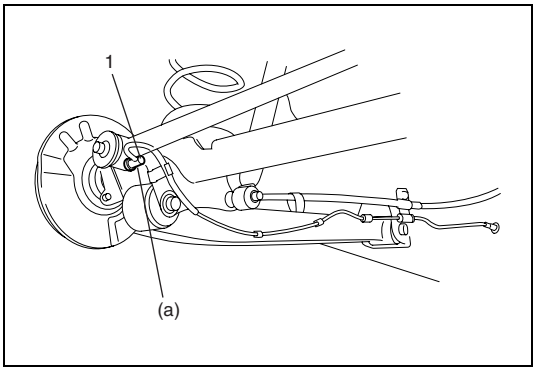


NOTE:

Do not reuse (reinstall) removed sensor ring.

1) Install new sensor ring (1) to rear wheel hub (2) using special tool and hydraulic press (3).

Special tool
(A): 09913-75840



2) Install rear wheel hub referring to “Wheel Bearing and Wheel Stud (For Sport Model) in Section 3F.
3) Install rear brake disc referring to “Rear Brake Disc” in Section 5
4) Install rear wheel speed sensor (1) to rear axle housing.

Tightening torque
Rear wheel speed sensor bolt
(a): 10 N·m (1.0 kg-m, 7.5 lb-ft)

Tightening Torque Specifications

Fastening part	Tightening torque		
	N•m	kg-m	lb-ft
Brake pipe flare nut	16	1.6	11.5
ABS hydraulic unit/control module assembly bolt	9	0.9	6.5
ABS hydraulic unit/control module assembly bracket bolt	26	2.6	18.0
Front wheel sensor ring bolt	10	1.0	7.5
Rear wheel sensor ring bolt	10	1.0	7.5

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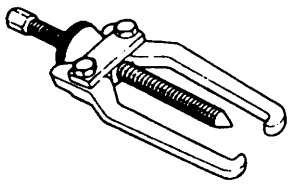
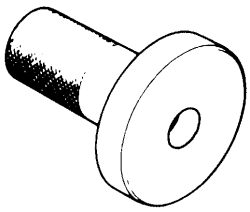
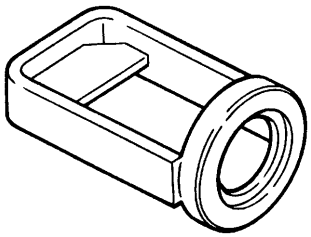
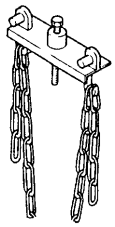
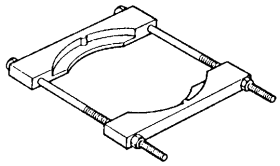
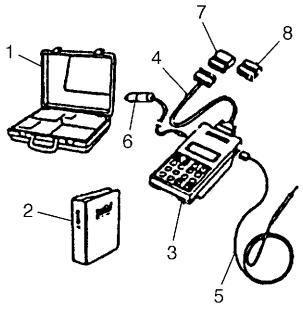
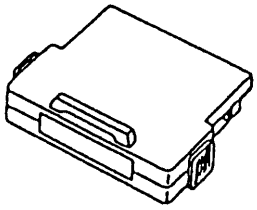
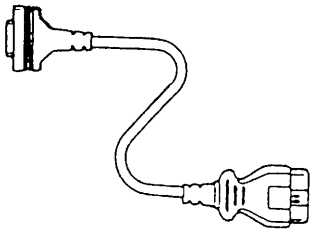
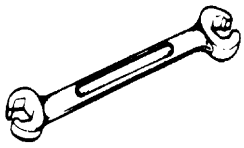
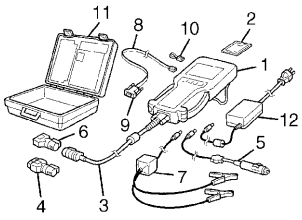
Special Tool

 09913-65135 Bearing puller	 09913-75520 Bearing installing tool	 09913-75840 Sensor ring installer	 09927-18411 Universal puller
 09921-57810 Countershaft holder	 09931-76011 Tech 1A kit (See NOTE “A”.)	 Mass storage cartridge	 09931-76030 16/14 pin DLC cable
 09950-78220 Flare nut wrench (10 mm)	 Tech 2 kit (SUZUKI scan tool) (See NOTE “B”.)		

NOTE:

- **“A”: This kit includes the following items and is usable only for except sport model.**
  1. Storage case, 2. Operator's manual, 3. Tech 1A, 4. DLC cable, 5. Test lead/probe, 6. Power source cable, 7. DLC cable adaptor, 8. Self-test adaptor
- **“B”: This kit includes the following items and is usable only for sport model.**
  1. Tech 2, 2. PCMCIA card, 3. DLC cable, 4. SAE 16/19 adapter, 5. Cigarette cable, 6. DLC loopback adaptor, 7. Battery power cable, 8. RS232 cable, 9. RS232 adaptor, 10. RS232 loopback connector, 11. Storage case, 12. Power supply

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SECTION 6-1

ENGINE GENERAL INFORMATION AND DIAGNOSIS (M15 ENGINE)

WARNING:

For vehicles equipped with a Supplemental Restraint (Air Bag) System :

- **Service on and around the air bag system components or wiring must be performed only by an authorized SUZUKI dealer. Refer to "Air Bag System Components and Wiring Location View" under "General Description" in air bag system section in order to confirm whether you are performing service on or near the air bag system components or wiring. Please observe all WARNINGS and "Service Precautions" under "On-Vehicle Service" in air bag system section before performing service on or around the air bag system components or wiring. Failure to follow WARNINGS could result in unintentional activation of the system or could render the system inoperative. Either of these two conditions may result in severe injury.**
- **Technical service work must be started at least 90 seconds after the ignition switch is turned to the "LOCK" position and the negative cable is disconnected from the battery. Otherwise, the system may be activated by reserve energy in the Sensing and Diagnostic Module (SDM).**

NOTE:

Whether the following systems (parts) are used in the particular vehicle or not depends on vehicle specifications. Be sure to bear this in mind when performing service work.

- **Secondary Heated oxygen sensor**
- **Immobilizer indicator lamp (vehicle with immobilizer indicator lamp can be identified also by HO2S-2)**
- **Diagnosis connector**

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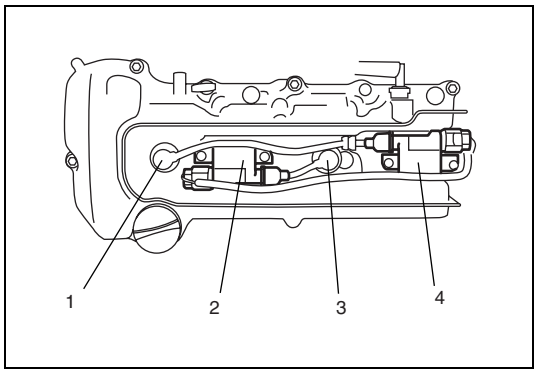
General Information

Statement on Cleanliness and Care

An automobile engine is a combination of many machined, honed, polished and lapped surfaces with tolerances that are measured in the thousands of an millimeter (ten thousands of an inch).
Accordingly, when any internal engine parts are serviced, care and cleanliness are important.
Throughout this section, it should be understood that proper cleaning and protection of machined surfaces and friction areas is part of the repair procedure. This is considered standard shop practice even if not specifically stated.

- A liberal coating of engine oil should be applied to friction areas during assembly to protect and lubricate the surfaces on initial operation.
- Whenever valve train components, pistons, piston rings, connecting rods, rod bearings, and crankshaft journal bearings are removed for service, they should be retained in order.
  At the time of installation, they should be installed in the same locations and with the same mating surfaces as when removed.
- Battery cables should be disconnected before any major work is performed on the engine.
  Failure to disconnect cables may result in damage to wire harness or other electrical parts.



- Throughout this manual, the four cylinders of the engine are identified by numbers; No.1 (1), No.2 (2), No.3 (3) and No.4 (4) counted from crankshaft pulley side to flywheel side.

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Precaution

Precaution on engine service

THE FOLLOWING INFORMATION ON ENGINE SERVICE SHOULD BE NOTED CAREFULLY, AS IT IS IMPORTANT IN PREVENTING DAMAGE, AND IN CONTRIBUTING TO RELIABLE ENGINE PERFORMANCE.

- When raising or supporting engine for any reason, do not use a jack under oil pan. Due to small clearance between oil pan and oil pump strainer, jacking against oil pan may cause it to be bent against strainer resulting in damaged oil pick-up unit.
- It should be kept in mind, while working on engine, that 12-volt electrical system is capable of violent and damaging short circuits.
  When performing any work where electrical terminals can be grounded, ground cable of the battery should be disconnected at battery.
- Any time the air cleaner, throttle body or intake manifold is removed, the intake opening should be covered. This will protect against accidental entrance of foreign material which could follow intake passage into cylinder and cause extensive damage when engine is started.

Precaution on fuel system service

- Work must be done with no smoking, in a well-ventilated area and away from any open flames.
- As fuel feed line (between fuel pump and fuel pressure regulator) is still under high fuel pressure even after engine was stopped, loosening or disconnecting fuel feed line directly may cause dangerous spout of fuel to occur where loosened or disconnected.
  Before loosening or disconnecting fuel feed line, make sure to release fuel pressure according to “Fuel Pressure Relief Procedure”. A small amount of fuel may be released after the fuel line is disconnected. In order to reduce the possibility of personal injury, cover the fitting to be disconnected with a shop cloth. Put that cloth in an approved container when disconnection is completed.
- Never run engine with fuel pump relay disconnected when engine and exhaust system are hot.

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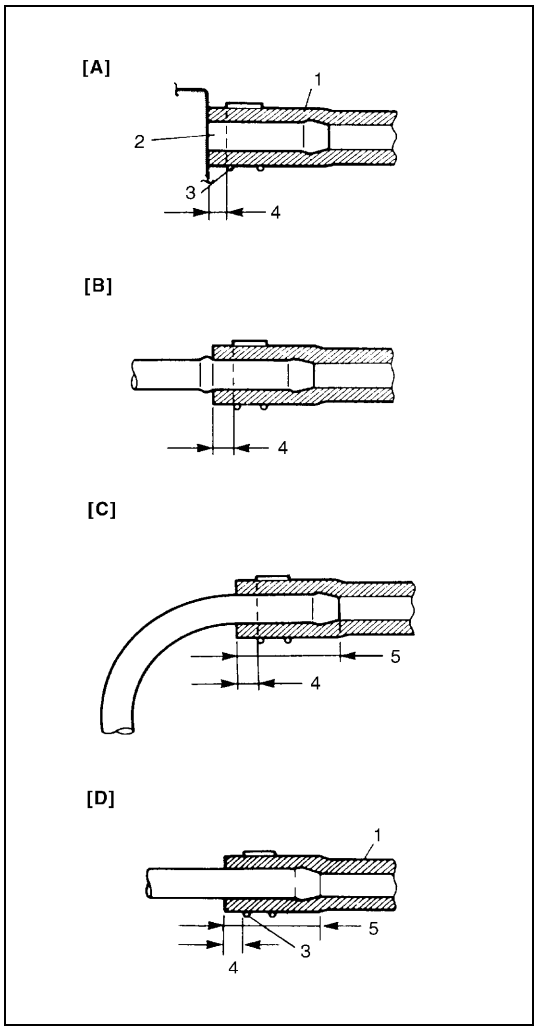

- Fuel or fuel vapor hose connection varies with each type of pipe. When reconnecting fuel or fuel vapor hose, be sure to connect and clamp each hose correctly referring to the figure Hose Connection.
  After connecting, make sure that it has no twist or kink.
- When installing injector, fuel feed pipe or lubricate its O-ring with gasoline.

[A]:	With short pipe, fit hose as far as it reaches pipe joint as shown.
[B]:	With following type pipe, fit hose as far as its peripheral projection as shown.
[C]:	With bent pipe, fit hose as its bent part as shown or till pipe is about 20 to 30 mm (0.79 – 1.18 in.) into the hose.
[D]:	With straight pipe, fit hose till pipe is, about 20 to 30 mm (0.79 – 1.18 in.) into the hose.
1.	Hose
2.	Pipe
3.	Clamp
4.	Clamp securely at a position 3 to 7 mm (0.12 – 0.27 in.) from hose end.
5.	20 to 30 mm (0.79 – 1.18 in.)

Fuel pressure relief procedure

CAUTION:
This work must not be done when engine is hot. If done so, it may cause adverse effect to catalyst.

NOTE:
During fuel pressure relief procedure, ECM may detect DTC(s). Therefore, check and clear DTC(s) by referring to "DTC Clearance" in this section after the following works.

After making sure that engine is cold, release fuel pressure as follows.

1) Place transmission gear shift lever in "Neutral", set parking brake, and block drive wheels.
2) Remove relay box cover.

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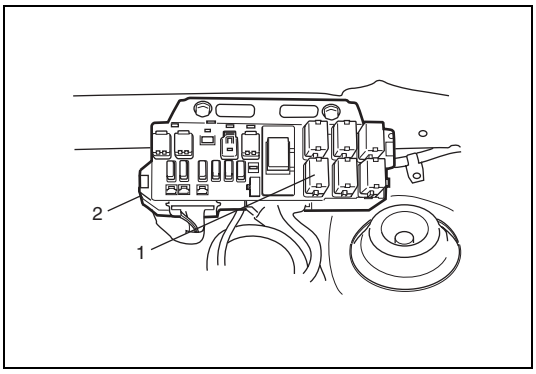

3) Disconnect fuel pump relay (1) from relay box.
4) Remove fuel filler cap to release fuel vapor pressure in fuel tank and then reinstall it.
5) Start engine and run it till it stops for lack of fuel. Repeat cranking engine 2-3 times for about 3 seconds each time to dissipate fuel pressure in lines. Fuel connections are now safe for servicing.
6) Upon completion of servicing, connect fuel pump relay (1) to relay box (2) and install relay box cover.
7) Clear DTC referring to “DTC clearance” if any.

Fuel leakage check procedure

After performing any service on fuel system, check to make sure that there are no fuel leakages as follows.

1) Turn ON ignition switch for 3 seconds (to operate fuel pump) and then turn it OFF.
   Repeat this (ON and OFF) 3 or 4 times and apply fuel pressure to fuel line. (till fuel pressure is felt by hand placed on fuel feed hose.)
2) In this state, check to see that there are no fuel leakages from any part of fuel system.

Diagnosis

Engine Diagnosis General Description

This vehicle is equipped with an engine and emission control system which are under control of ECM.
The engine and emission control system in this vehicle are controlled by ECM. ECM has an On-Board Diagnostic system which detects a malfunction in this system and abnormality of those parts that influence the engine exhaust emission. When diagnosing engine troubles, be sure to have full understanding of the outline of “On-Board Diagnostic System” and each item in “Precaution in Diagnosing Trouble” and execute diagnosis according to “Engine and Emission Control System Check”.
There is a close relationship between the engine mechanical, engine cooling system, ignition system, exhaust system, etc. and the engine and emission control system in their structure and operation. In case of an engine trouble, even when the malfunction indicator lamp (MIL) doesn’t turn ON, it should be diagnosed according to this flow table.

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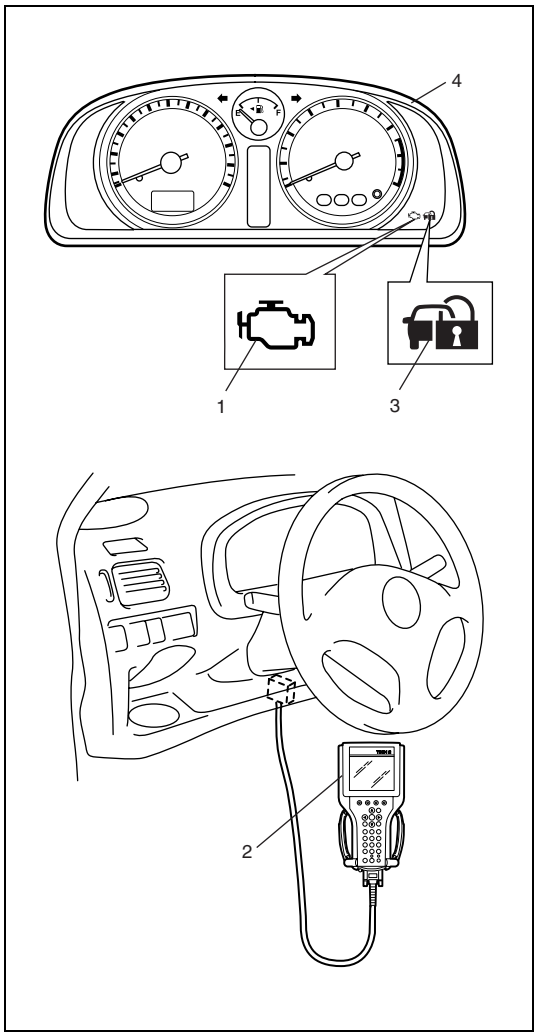
On-board Diagnostic System Description (Vehicle with Immobilizer Indicator Lamp)



ECM in this vehicle has following functions.

- When the ignition switch is turned ON with the engine at a stop, malfunction indicator lamp (MIL) (1) turns ON to check the malfunction indicator lamp (1) in the combination meter (4) and its circuit.
- When ECM detects a malfunction which gives an adverse effect to vehicle emission while the engine is running, it makes the malfunction indicator lamp (1) in the combination meter turn ON or flash (flashing only when detecting a misfire which can cause damage to the catalyst) and stores the malfunction area in its memory.
  (If it detects that continuously 3 driving cycles are normal after detecting a malfunction, however, it makes MIL (1) turn OFF although DTC stored in its memory will remain.)
- As a condition for detecting a malfunction in some areas in the system being monitored by ECM and turning ON the malfunction indicator lamp (1) due to that malfunction, 2 driving cycle detection logic is adopted to prevent erroneous detection.
- When a malfunction is detected, engine and driving conditions then are stored in ECM memory as freeze frame data. (For the details, refer to description on Freeze frame data.)
- It is possible to communicate by using not only SUZUKI scan tool (2) but also OBD generic scan tool. (Diagnostic information can be accessed by using a scan tool.)

3. Immobilizer indicator lamp

Warm-up cycle

A warm-up cycle means sufficient vehicle operation such that the coolant temperature has risen by at least 22°C (40°F) from engine starting and reaches a minimum temperature of 70°C (160°F).

Driving cycle

A “Driving Cycle” consists of engine startup, driving mode where a malfunction would be detected if present, and engine shutoff.

2 driving cycles detection logic

The malfunction detected in the first driving cycle is stored in ECM memory (in the form of pending DTC and freeze frame data) but the malfunction indicator lamp does not light at this time. It lights up at the second detection of same malfunction also in the next driving cycle.

Pending DTC

Pending DTC means a DTC detected and stored temporarily at the first driving cycle of the DTC which is detected in the 2 driving cycle detection logic.

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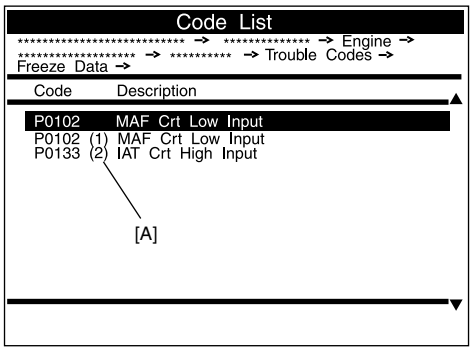
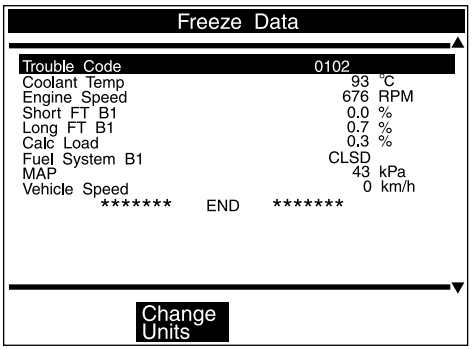

Code List
********** → ********** → Engine →
********** → ********** → Trouble Codes →
Freeze Data →
Code Description
P0102 MAF Crt Low Input
P0102 (1) MAF Crt Low Input
P0133 (2) IAT Crt High Input
[A]



Freeze frame data

ECM stores the engine and driving conditions (in the form of data as shown in the figure) at the moment of the detection of a malfunction in its memory. This data is called “Freeze frame data”. Therefore, it is possible to know engine and driving conditions (e.g., whether the engine was warm or not, where the vehicle was running or stopped, where air/fuel mixture was lean or rich) when a malfunction was detected by checking the freeze frame data. Also, ECM has a function to store each freeze frame data for three different malfunctions in the order as the malfunction is detected. Utilizing this function, it is possible to know the order of malfunctions that have been detected. Its use is helpful when rechecking or diagnosing a trouble.

Priority of freeze frame data:

ECM has 4 frames where the freeze frame data can be stored. The first frame stores the freeze frame data of the malfunction which was detected first. However, the freeze frame data stored in this frame is updated according to the priority described below. (If malfunction as described in the upper square “1” below is detected while the freeze frame data in the lower square “2” has been stored, the freeze frame data “2” will be updated by the freeze frame data “1”.)

[A]: 1st or 2nd in parentheses here represents which position in the order the malfunction is detected.

PRIORITY	FREEZE FRAME DATA IN FRAME 1
1	Freeze frame data at initial detection of malfunction among misfire detected (P0300-P0304), fuel system too lean (P0171) and fuel system too rich (P0172)
2	Freeze frame data when a malfunction other than those in “1” above is detected

In the 2nd through the 4th frames, the freeze frame data of each malfunction is stored in the order as the malfunction is detected. These data are not updated.
Shown in the table below are examples of how freeze frame data are stored when two or more malfunctions are detected.

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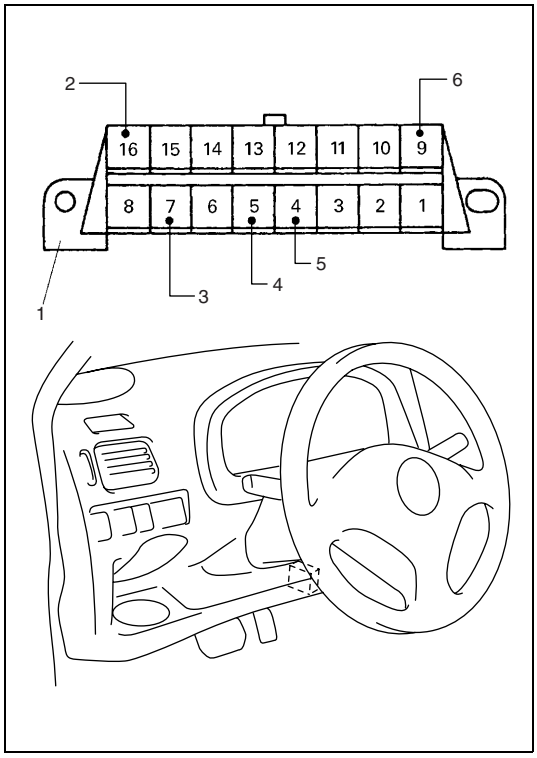
			FRAME			
			FRAME 1	FRAME 2	FRAME 3	FRAME4
			FREEZE FRAME DATA to be updated	1st FREEZE FRAME DATA	2nd FREEZE FRAME DATA	3rd FREEZE FRAME DATA
MALFUNCTION DETECTED ORDER		No malfunction	No freeze frame data			
	1	P0400 (EGR) detected	Data at P0400 detection	Data at P0400 detection	–	–
	2	P0171 (Fuel system) detected	Data at P0171 detection	Data at P0400 detection	Data at P0171 detection	–
	3	P0300 (Misfire) detected	Data at P0171 detection	Data at P0400 detection	Data at P0171 detection	Data at P0300 detection
	4	P0301 (Misfire) detected	Data at P0171 detection	Data at P0400 detection	Data at P0171 detection	Data at P0300 detection

Freeze frame data clearance:

The freeze frame data is cleared at the same time as clearance of diagnostic trouble code (DTC).

Data link connector (DLC)



DLC (1) is in compliance with SAEJ1962 in its installation position, the shape of connector and pin assignment.

Serial data line (K line of ISO 9141) is used for SUZUKI scan tool or OBD generic scan tool to communicate with ECM, TCM, ABS control module and Air bag SDM.
SUZUKI serial data line is used for SUZUKI scan tool to communicate with immobilizer control module.

2. B+
3. Serial data line (K line of ISO 9141)
4. ECM ground
5. Body ground
6. SUZUKI serial data line

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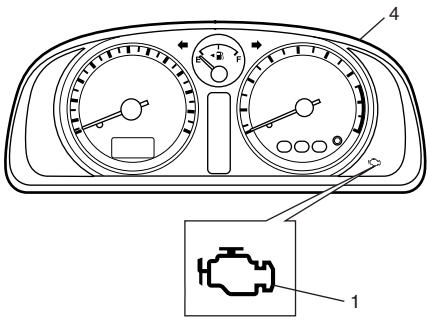
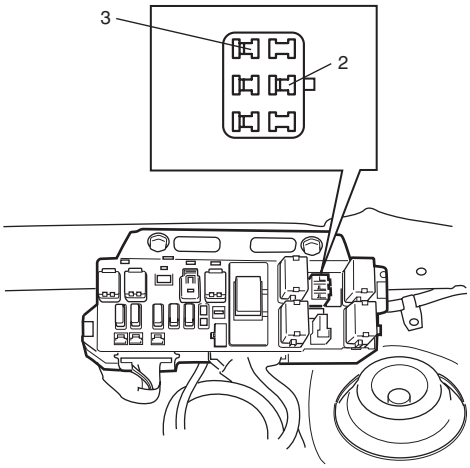
On-board Diagnostic System Description (Vehicle without Immobilizer Indicator Lamp)





ECM diagnosis troubles which may occur in the area including the following parts when the ignition switch is ON and the engine is running, and indicates the result by turning on or flashing malfunction indicator lamp (1).

- Heated oxygen sensor (if equipped)
- ECT sensor
- TP sensor
- IAT sensor
- MAP sensor
- CMP sensor
- CKP sensor
- Knock sensor (if equipped)
- VSS
- CPU (Central Processing Unit) of ECM

ECM and malfunction indicator lamp (1) operate as follows.

- Malfunction indicator lamp (1) lights when the ignition switch is turned ON (but the engine at stop) with the diagnosis switch terminal ungrounded regardless of the condition of Engine and Emission control system. This is only to check the malfunction indicator lamp (1) in the combination meter (4) and its circuit.
- If the above areas of Engine and Emission control system are free from any trouble after the engine start (while engine is running), malfunction indicator lamp (1) turns OFF.
- When ECM detects a trouble which has occurred in the above areas, it makes malfunction indicator lamp (1) turn ON while the engine is running to warn the driver of such occurrence of trouble and at the same time it stores the trouble area in ECM back-up memory. (The memory is kept as it is even if the trouble was only temporary and disappeared immediately. And it is not erased unless the power to ECM is shut off for specified time below.)
  ECM also indicates trouble area in memory by means of flashing of malfunction indicator lamp (1) at the time of inspection. (i.e. when diagnosis switch terminal (2) is connected to ground terminal (3) with a service wire and ignition switch is turned ON.)

NOTE:

- **When a trouble occurs in the above areas and disappears soon while the diagnosis switch terminal is ungrounded and the engine is running, malfunction indicator lamp (1) lights and remains ON as long as the trouble exists but it turns OFF when the normal condition is restored.**
- **Time required to erase diagnostic trouble code memory thoroughly varies depending on ambient temperature as follows.**

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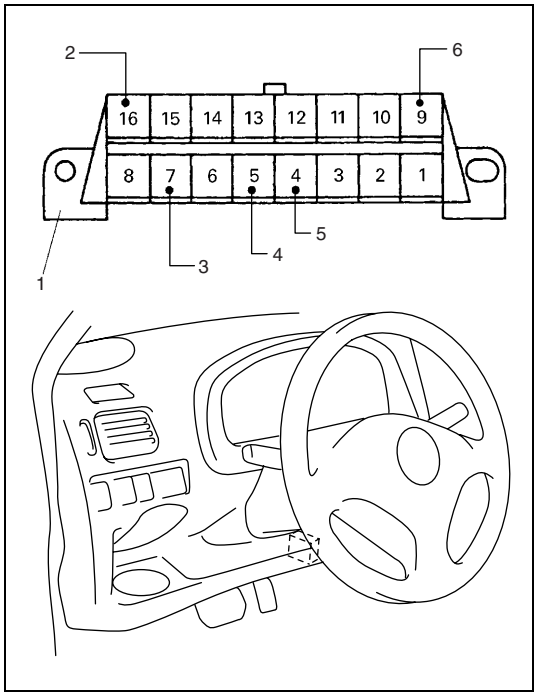
AMBIENT TEMPERATURE	TIME TO CUT POWER TO ECM
Over 0°C (32°F)	60 sec. or longer
Under 0°C (32°F)	Not specifiable. Select a place with temperature higher than 0°C (32°F).

Data link connector (DLC)



DLC (1) is in compliance with SAEJ1962 in its installation position, the shape of connector and pin assignment.

Serial data line (K line of ISO 9141) is used for SUZUKI scan tool to communicate with ECM, TCM, ABS control module and Air bag SDM.
SUZUKI serial data line is used for SUZUKI scan tool to communicate with immobilizer control module.

2. B+
3. Serial data line (K line of ISO 9141)
4. ECM ground
5. Body ground
6. SUZUKI serial data line

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Precaution in Diagnosing Trouble for Engine

- Do not disconnect couplers from ECM, battery cable from battery, ECM ground wire harness from engine or main fuse before confirming diagnostic information (DTC, freeze frame data, etc.) stored in ECM memory. Such disconnection will erase memorized information in ECM memory.
- Diagnostic information stored in ECM memory can be cleared as well as checked by using SUZUKI scan tool or generic scan tool. Before using scan tool, read its Operator's (Instruction) Manual carefully to have good understanding as to what functions are available and how to use it.
- Priorities for diagnosing troubles (Vehicle with immobilizer indicator lamp).
  If two or more DTCs are stored, proceed to the flow table of the DTC which has detected earliest in the order (it can be identified by referring to freeze frame data) and follow the instruction in that table.
  If no instructions are given, troubleshoot diagnostic trouble codes according to the following priorities.
  – Diagnostic trouble codes (DTCs) other than DTC P0171/P0172 (Fuel system too lean/too rich), DTC P0300/P0301/P0302/P0303/P0304 (Misfire detected) and DTC P0400 (EGR flow malfunction)
  – DTC P0171/P0172 (Fuel system too lean/too rich) and DTC P0400 (EGR flow malfunction)
  – DTC P0300/P0301/P0302/P0303/P0304 (Misfire detected)
- Be sure to read "Precautions for Electrical Circuit Service" in Section 0A before inspection and observe what is written there.
- ECM Replacement
  When substituting a known-good ECM, check for following conditions. Neglecting this check may cause damage to a known-good ECM.
  – Resistance value of all relays, actuators is as specified respectively.
  – MAP sensor and TP sensor are in good condition and none of power circuits of these sensors is shorted to ground.

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Engine and Emission Control System Check

Refer to the following pages for the details of each step.

Step	Action	Yes	No
1	Customer Complaint Analysis 1) Perform customer complaint analysis referring to the followings. Was customer complaint analysis performed?	Go to Step 2.	Perform customer complaint analysis.
2	DTC and Freeze Frame Data Check, Record and Clearance 1) Check for DTC (including pending DTC) referring to the followings. Is there any DTC(s)?	Print DTC and freeze frame data or write them down and clear them by referring to “DTC Clearance” section. Go to Step 3.	Go to Step 4.
3	Visual Inspection 1) Perform visual inspection referring to the followings. Is there any faulty condition?	Repair or replace malfunction part. And then Go to Step 11.	Go to Step 5.
4	Visual Inspection 1) Perform visual inspection referring to the followings. Is there any faulty condition?		Go to Step 8.
5	Trouble Symptom Confirmation 1) Confirm trouble symptom referring to the followings. Is trouble symptom identified?	Go to Step 6.	Go to Step 7.
6	Rechecking and Record of DTC/Freeze Frame Data 1) Recheck for DTC and freeze frame data referring to “Diagnostic Trouble Code (DTC) Check” in this section. Is there any DTC(s)?	Go to Step 9.	Go to Step 8.
7	Rechecking and Record of DTC/Freeze Frame Data 1) Recheck for DTC and freeze frame data referring to “Diagnostic Trouble Code (DTC) Check” in this section. Is there any DTC(s)?		Go to Step 10.
8	Engine Basic Inspection and Engine Diagnosis Table 1) Check and repair according to “Engine Basic Inspection” and “Engine Symptom Diagnosis” in this section. Are check and repair complete?	Go to Step 11.	Check and repair malfunction part(s). And then Go to Step 11.
9	Trouble shooting for DTC 1) Check and repair according to applicable DTC diag. flow table. Are check and repair complete?		
10	Check for Intermittent Problems 1) Check for intermittent problems by referring to the followings. Is there any faulty condition?	Repair or replace malfunction part(s). Go to Step 11.	Go to Step 11.
11	Final Confirmation Test 1) Clear DTC if any. 2) Perform final confirmation test by referring to the followings. Is there any problem symptom, DTC or abnormal condition?	Go to Step 6.	End.

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1. Customer Complaint Analysis

Record details of the problem (failure, complaint) and how it occurred as described by the customer. For this purpose, use of such an inspection form will facilitate collecting information to the point required for proper analysis and diagnosis.

2. DTC/FReeze Frame Data Check, Record and Clearance

First, check DTC (including pending DTC), referring to “DTC check” section. If DTC is indicated, print it and freeze frame data or write them down and then clear them by referring to “DTC clearance” section. DTC indicates malfunction that occurred in the system but does not indicate whether it exists now or it occurred in the past and the normal condition has been restored now. To check which case applies, check the symptom in question according to Step 4 and recheck DTC according to Step 5.
Attempt to diagnose a trouble based on DTC in this step only or failure to clear the DTC in this step will lead to incorrect diagnosis, trouble diagnosis of a normal circuit or difficulty in troubleshooting.

NOTE:
If only Immobilizer DTCs (P1620-P1623) are indicated in this step, perform trouble diagnosis according to “Diagnosis” in Section 8G.

3. and 4. Visual Inspection

As a preliminary step, be sure to perform visual check of the items that support proper function of the engine referring to “Visual Inspection” section.

5. Trouble Symptom Confirmation

Based on information obtained in Step 1 Customer complaint analysis and Step 2 DTC/freeze frame data check, confirm trouble symptoms. Also, reconfirm DTC according to “DTC Confirmation Procedure” described in each DTC Diagnosis section.

6. and 7. Rechecking and Record of DTC/Freeze Frame Data

Refer to “Diagnostic Trouble Code (DTC) Check” in this section for checking procedure.

8. Engine Basic Inspection and Engine Diagnosis Table

Perform basic engine check according to the “Engine Basic Inspection” first. When the end of the flow table has been reached, check the parts of the system suspected as a possible cause referring to “Engine Symptom Diagnosis” and based on symptoms appearing on the vehicle (symptoms obtained through steps of customer complaint analysis, trouble symptom confirmation and/or basic engine check) and repair or replace faulty parts, if any.

9. Troubleshooting for DTC (See each DTC Diag. Flow Table)

Based on the DTC indicated in Step 5 and referring to the applicable DTC diag. flow table in this section, locate the cause of the trouble, namely in a sensor, switch, wire harness, connector, actuator, ECM or other part and repair or replace faulty parts.

10. Check for Intermittent Problem

Check parts where an intermittent trouble is easy to occur (e.g., wire harness, connector, etc.), referring to “INTERMITTENT AND POOR CONNECTION” in Section 0A and related circuit of DTC recorded in Step 2.

11. Final Confirmation Test

Confirm that the problem symptom has gone and the engine is free from any abnormal conditions. If what has been repaired is related to the DTC, clear the DTC once, perform DTC confirmation procedure and confirm that no DTC is indicated.

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Customer Problem Inspection Form (Example)

User name:	Model:	VIN:	
Date of issue:	Date Reg.	Date of problem:	Mileage:

PROBLEM SYMPTOMS	
☐ **Difficult Starting** ☐ No cranking ☐ No initial combustion ☐ No combustion ☐ Poor starting at (☐cold ☐warm ☐always) ☐ Other_____	☐ **Poor Driveability** ☐ Hesitation on acceleration ☐ Back fire/☐After fire ☐ Lack of power ☐ Surging ☐ abnormal knocking ☐ Other_____
☐ **Poor Idling** ☐ Poor fast idle ☐ Abnormal idling speed (☐High ☐Low) (r/min.) ☐ Unstable ☐ Hunting (r/min. to r/min.) ☐ Other_____	☐ **Engine Stall when** ☐ Immediately after start ☐ Accel. pedal is depressed ☐ Accel. pedal is released ☐ Load is applied ☐ A/C ☐Electric load ☐P/S ☐ Other_____ ☐ Other_____
☐ OTHERS:	

VEHICLE/ENVIRONMENTAL CONDITION WHEN PROBLEM OCCURS	
Environmental Condition	
Weather Temperature Frequency Road	☐Fair ☐Cloudy ☐Rain ☐Snow ☐Always ☐Other_____ ☐Hot ☐Warm ☐Cool ☐Cold (°F/ °C) ☐Always ☐Always ☐Sometimes (times/ day, month) ☐Only once ☐Under certain condition ☐Urban ☐Suburb ☐Highway ☐Mountainous (☐Uphill ☐Downhill) ☐Tarmacadam ☐Gravel ☐Other_____
Vehicle Condition	
Engine condition	☐Cold ☐Warming up phase ☐Warmed up ☐Always ☐Other at starting ☐Immediately after start ☐Racing without load ☐Engine speed (r/min)
Vehicle condition	During driving: ☐Constant speed ☐Accelerating ☐Decelerating ☐Right hand corner ☐Left hand corner ☐When shifting (Lever position) ☐At stop ☐Vehicle speed when problem occurs (km/h, Mile/h) ☐Other

Malfunction indicator lamp condition	☐Always ON ☐Sometimes ON ☐Always OFF ☐Good condition	
Diagnostic trouble code	First check:	☐No code ☐Malfunction code ( )
	Second check:	☐No code ☐Malfunction code ( )

NOTE:

The above form is a standard sample. It should be modified according to conditions characteristic of each market.

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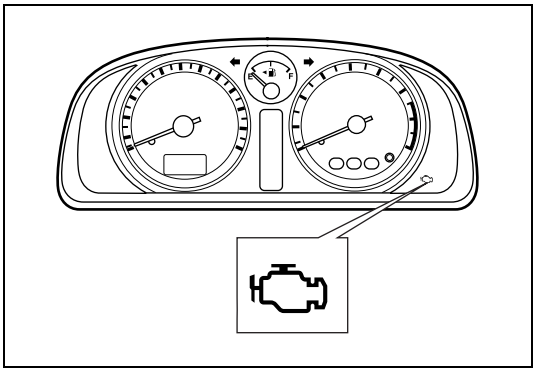
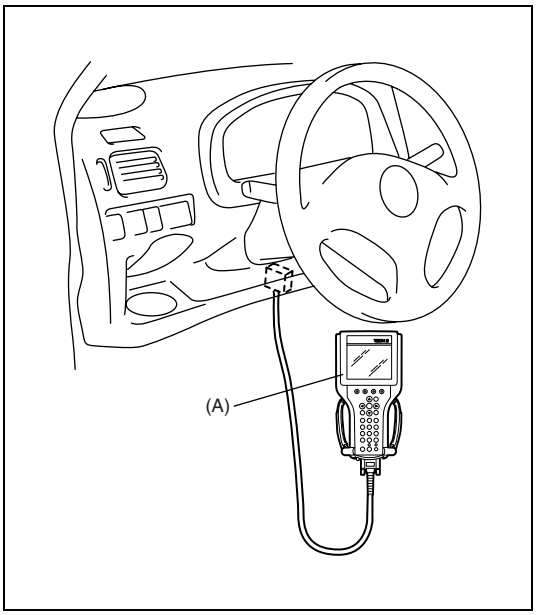
Malfunction Indicator Lamp (MIL) Check



1) Turn ON ignition switch (but the engine at stop) and check that MIL lights.
   If MIL does not light up (or MIL dims), go to "Diagnostic Flow Table A-1" for troubleshooting.
   If MIL flushes, go to "Diagnostic Flow Table A-3" (vehicle without immobilizer indicator lamp).
2) Start engine and check that MIL turns OFF.
   If MIL remains ON and no DTC is stored in ECM, go to "Diagnostic Flow Table A-2" for troubleshooting.

Diagnostic Trouble Code (DTC) Check

[Using SUZUKI scan tool]



1) Prepare SUZUKI scan tool.
2) With ignition switch OFF, connect it to data link connector (DLC) (1) located on underside of instrument panel at driver's seat side.

Special tool
(A): SUZUKI scan tool

3) Turn ignition switch ON and confirm that MIL lights.
4) Read DTC, pending DTC and freeze frame data according to instructions displayed on scan tool and print it or write it down.
   Refer to scan tool operator's manual for further details.
   If communication between scan tool and ECM is not possible, check if scan tool is communicable by connecting it to ECM in another vehicle. If communication is possible in this case, scan tool is in good condition. Then check data link connector and serial data line (circuit) in the vehicle with which communication was not possible.
5) After completing the check, turn ignition switch off and disconnect scan tool from data link connector.

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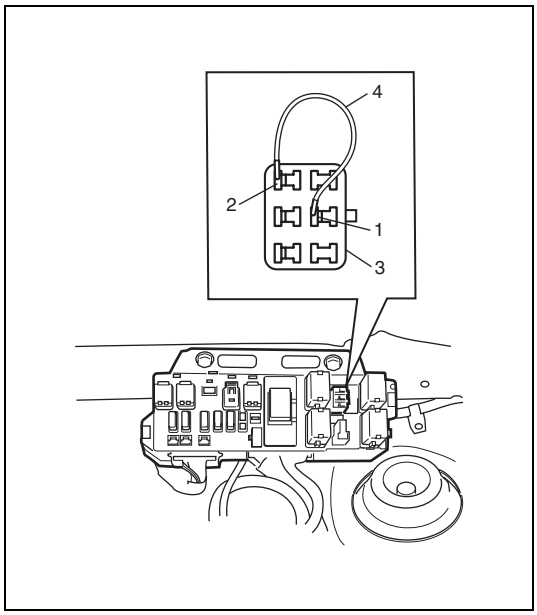
[Without using SUZUKI scan tool] (vehicle without immobilizer indicator lamp)



1) Check malfunction indicator lamp referring to “Malfunction Indicator Lamp Check” in this section.
2) With the ignition switch OFF position, disconnect SUZUKI scan tool if connected and using service wire (4), connect diagnosis switch terminal (1) to ground terminal (2) in diagnosis connector (3).
3) With the ignition switch ON position and leaving engine OFF, read DTC from flashing pattern of malfunction indicator lamp. Refer to “Diagnostic Trouble Code Table”.
   If lamp remains ON, go to “Diagnostic Flow Table A-4”.

NOTE:

- **If abnormality or malfunction lies in two or more areas, malfunction indicator lamp indicates applicable codes three times each.**
  And flashing of these codes is repeated as long as diagnosis terminal is grounded and ignition switch is held at ON position.
- **Take a note of diagnostic trouble code indicated first.**

4) After completing the check, turn the ignition switch OFF position and disconnect service wire from diagnosis connector.

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Diagnostic Trouble Code (DTC) Clearance

Using scan tool

1) Connect SUZUKI scan tool or OBD generic scan tool (Vehicle with immobilizer indicator lamp) to data link connector in the same manner as when making this connection for DTC check.
2) Turn ignition switch ON.
3) Erase DTC and pending DTC according to instructions displayed on scan tool. Refer to scan tool operator's manual for further details.
4) After completing the clearance, turn ignition switch off and disconnect scan tool from data link connector.

NOTE:

DTC and freeze frame data stored in ECM memory are also cleared in following cases. Be careful not to clear them before keeping their record.

- **When power to ECM is cut off (by disconnecting battery cable, removing fuse or disconnecting ECM connectors)**
- **When the same malfunction (DTC) is not detected again during 40 engine warm-up cycles. (Vehicle with immobilizer indicator lamp)**

Without using scan tool

1) Turn the ignition switch OFF position.
2) Disconnect battery negative cable for specified time below to erase diagnostic trouble code stored in ECM memory and reconnect it.

Time required to erase DTC:

Ambient temperature	Time to cut power to ECM
Over 0°C (32°F)	30 sec. or longer
Under 0°C (32°F)	Not specifiable. Select a place with higher than 0°C (32°F) temperature.

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Diagnostic Trouble Code (DTC) Table

DTC NO.	DETECTING ITEM	DETECTING CONDITION (DTC will set when detecting:)	MIL (vehicle with immobilizer indicator lamp)	MIL (vehicle without immobilizer indicator lamp)
P0010 (No.33)	Camshaft position actuator circuit	Actual valve timing fails to become close to target advance level of each function although advance control function or retarding control function is at work.	1driving cycle	1driving cycle
P0011 (No.32)	Camshaft position – timing over-advanced or system performance	Actual valve of advanced valve timing does not reach target value, or valve timing is advanced although ECM command is most retarding.	2 driving cycles	2 driving cycles
P0012 (No.32)	Camshaft position – timing over-retarded		2 driving cycles	2 driving cycles
P0105 (No.11)	Manifold absolute pressure circuit malfunction	Low pressure-high vacuum-low voltage (or MAP sensor circuit shorted to ground) High pressure-low vacuum-high voltage (or MAP sensor circuit open)	1 driving cycle	1 driving cycle
P0110 (No.18)	Intake air temp. circuit malfunction	Intake air temp. circuit low input Intake air temp. circuit high input	1 driving cycle	1 driving cycle
P0115 (No.19)	Engine coolant temp. circuit malfunction	Engine coolant temp. circuit low input Engine coolant temp. circuit high input	1 driving cycle	1 driving cycle
P0120 (No.13)	Throttle position circuit malfunction	Throttle position circuit low input Throttle position circuit high input	1 driving cycle	1 driving cycle
P0121	Throttle position circuit performance problem	Poor performance of TP sensor	2 driving cycles	Not applicable
P0130 (No.14)	HO2S circuit malfunction (Sensor–1)	Min. output voltage of HO2S–higher than specification Max. output voltage of HO2S–lower than specification	2 driving cycle	1 driving cycle
P0133	HO2S circuit slow response (Sensor–1)	Response time of HO2S–1 output voltage between rich and lean is longer than specification.	2 driving cycles	Not applicable
P0134	HO2S circuit no activity detected (Sensor–1)	Output voltage of HO2S–1 fails to go above specification (or HO2S–1 circuit shorted to ground).	2 driving cycles	1 driving cycle
P0135 (No.14)	HO2S heater circuit malfunction (Sensor–1)	Terminal voltage is lower than specification at heater OFF or it is higher at heater ON.	2 driving cycles	1 driving cycle
P0136	HO2S circuit malfunction (Sensor–2)	Max. voltage of HO2S–2 is lower than specification or its min. voltage is higher than specification	2 driving cycles	Not applicable
P0141	HO2S heater circuit malfunction (Sensor–2)	Terminal voltage is lower than specification at heater OFF or it is higher at heater ON. (or heater circuit or short)	2 driving cycles	Not applicable
P0171	Fuel system too lean	Short term fuel trim or total fuel trim (short and long terms added) is larger than specification for specified time or longer. (fuel trim toward rich side is large.)	2 driving cycles	Not applicable

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DTC NO.	DETECTING ITEM	DETECTING CONDITION (DTC will set when detecting:)	MIL (vehicle with immobilizer indicator lamp)	MIL (vehicle without immobilizer indicator lamp)
P0172	Fuel system too rich	Short term fuel trim or total fuel trim (short and long term added) is smaller than specification for specified time or longer. (fuel trim toward lean side is large.)	2 driving cycles	Not applicable
P0300 P0301 P0302 P0303 P0304	Random misfire detected Cylinder 1 misfire detected Cylinder 2 misfire detected Cylinder 3 misfire detected Cylinder 4 misfire detected	Misfire of such level as to cause damage to three way catalyst	✱1 driving cycle MIL flashing during misfire detection	Not applicable
		Misfire of such level as to deteriorate emission but not to cause damage to three way catalyst	2 driving cycles	Not applicable
P0325 (No.17)	Knock sensor circuit malfunction	Knock sensor circuit low input Knock sensor circuit high input	1 driving cycle	1 driving cycle
P0335 (No.23)	Crankshaft position sensor circuit malfunction	No signal for 2 sec. during engine cranking	1 driving cycle	1 driving cycle
P0340 (No.15)	Camshaft position sensor circuit malfunction	No signal during engine running	1 driving cycle	1 driving cycle
P0400	Exhaust gas recirculation flow malfunction detected	Excessive or insufficient EGR flow	2 driving cycles	Not applicable
P0420	Catalyst system efficiency below threshold	Output waveforms of HO2S–1 and HO2S–2 are similar. (Time from output voltage change of HO2S–1 to that of HO2S–2 is shorter than specification.)	2 driving cycles	Not applicable
P0443	Purge control valve circuit malfunction	Purge control valve circuit is open or shorted to ground	2 driving cycles	Not applicable
P0480	Radiator fan control circuit malfunction	Radiator cooling fan relay terminal voltage is low when cooling temp. is lower than specification	2 driving cycles	Not applicable
P0500 (No.16)	Vehicle speed sensor malfunction	No signal while running in “D” range or during fuel cut at decelerating	2 driving cycles	1 driving cycle
P0505	Idle control system malfunction	No closed signal to IAC valve is detected	2 driving cycles	Not applicable
P0601 (No.71)	Internal control module memory check sum error	Data write error (or check sum error) when written into ECM	2 driving cycles	1 driving cycle
P1450 (No.29)	Barometric pressure sensor circuit malfunction	Barometric pressure is lower or higher than specification. (or sensor malfunction)	1 driving cycle	1 driving cycle
P1451	Barometric pressure sensor performance problem	Difference between manifold absolute pressure (MAP sensor value) and barometric pressure (barometric pressure sensor value) is larger than specification during cranking.	2 driving cycles	Not applicable

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DTC NO.	DETECTING ITEM	DETECTING CONDITION (DTC will set when detecting:)	MIL (vehicle with immobilizer indicator lamp)	MIL (vehicle without immobilizer indicator lamp)
P1500	Starter signal circuit malfunction	Starter signal is not inputted from engine cranking till its start and after or it is always inputted	2 driving cycles	Not applicable
P1510	ECM backup power source malfunction	No backup power after starting engine	1 driving cycle	Not applicable

DTC NO.	DETECTING ITEM	DETECTING CONDITION (DTC will set when detecting:)	MIL
P1620 (No.84)	ECU code not registered	Refer to Section 8G	
P1621 (No.83)	No ECU code transmitted from Immobilizer Control Module		
P1622 (No.82)	Fault in ECM		
P1623 (No.81)	ECU code not matched		

NOTE:

- **For parenthetic No. (No.), in DTC column, it is used for vehicle without immobilizer indication lamp.**
- **DTC No.12 appears when none of the other codes is identified.**
- **1 driving cycle: MIL lights up when DTC is detected while 1 driving cycles.**
- **2 driving cycles: MIL lights up when the same DTC is detected also in the next driving cycle after DTC is detected and stored temporarily in the first driving cycle.**
- **∗1 driving cycle:**
  MIL blinks. Refer to "DTC P0300/P0301/P0302/P0303/P0304: Random Misfire/Cylinder 1 Misfire/Cylinder 2 Misfire/Cylinder 3 Misfire/Cylinder 4 Misfire Detected" for details.

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Fail-Safe Table

When any of the following DTCs is detected, ECM enters fail-safe mode as long as malfunction continues to exist but that mode is canceled when ECM detects normal condition after that.

DTC NO.	TROUBLE AREA	FAIL-SAFE OPERATION	SYMPTOM
P0105 (No.11)	MAP SENSOR	ECM uses value determined by throttle opening and engine speed. ECM stops EGR, EVAP purge, variable intake valve timing control and idle air control.	Hard starting/ rough or incorrect idle/ excessive fuel consumption/ hesitation/ poor acceleration/ surge/ detonation or spark knock
P0110 (No.18)	IAT SENSOR	ECM controls actuators assuming that intake air temperature is 20°C.	Hard starting/ rough or incorrect idle/ excessive fuel consumption/ hesitation poor acceleration/ detonation or spark knock
P0115 (No.19)	ECT SENSOR	ECM controls actuators assuming that engine coolant temperature is 80°C. Radiator fan motor ON. ECM stops variable intake valve timing control.	Hard starting/ rough or incorrect idle/ excessive fuel consumption/ hesitation poor acceleration/ detonation or spark knock
P0120 (No.13)	TP SENSOR	ECM controls actuators assuming that throttle opening is 20°. ECM stops variable intake valve timing control.	Rough or incorrect idle/ excessive fuel consumption/ hesitation/ poor acceleration
P0130, P0134 (No.14)	HEATED OXYGEN SENOR-1	– ECM stops variable intake valve timing control.	Hard starting/rough or incorrect idle/ excessive fuel consumption/ hesitation/ poor acceleration
P0325 (No.17)	KNOCK SENSOR	–	Detonation/ spark knock
P0335 (No.23)	CKP SENSOR	Fix ignition timing. ECM changes injection control system from sequential injection to simultaneous one. ECM stops variable intake valve timing control.	Hard staring/ engine stall
P0010 (No.33), P0011, P0012 (No.32)	VARIABLE INTAKE VALVE TIMING CONTROL SYSTEM	ECM stops variable intake valve timing control.	Hard starting/rough or incorrect idle/ excessive fuel consumption/ hesitation/ poor acceleration/ surge/ detonation or spark knock/ engine stall
P0340 (No.15)	CMP SENSOR	ECM changes injection control system from sequential injection to simultaneous one. ECM stops variable intake valve timing control.	Hard starting
P0400	EGR VALVE	–	Hard starting/rough or incorrect idle/ excessive fuel consumption/ hesitation/ poor acceleration/ surge/ detonation or spark knock/ engine stall
P0420	CATALYST	–	–

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DTC NO.	TROUBLE AREA	FAIL-SAFE OPERATION	SYMPTOM
P0443	PURGE CONTROL VALVE	–	Rough or incorrect idle/ surge/ hard starting/ engine stall
P0480	RADIATOR FAN CONTROL SYSTEM	–	Engine overheating
P0500 (No.16)	VEHICLE SPEED SENSOR	ECM stops variable intake valve timing control and idle air control.	Rough or incorrect idle
P0505	IDLE CONTROL SYSTEM	–	Engine stall/ rough or incorrect idle
P0601 (No.71)	ECM INTERNAL	–	Hard starting/ rough or incorrect idle/ excessive fuel consumption/ detonation or spark knock/ hesitation poor acceleration/
P1450 (No.29)	BAROMETRIC PRESSURE SENSOR	ECM controls actuators assuming that barometric pressure is 100 kPa (760 mmHg).	Hard starting/ rough or incorrect idle

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Visual Inspection

Visually check the following parts and systems.

INSPECTION ITEM	REFERRING SECTION
• Engine oil – level, leakage	"Engine Oil and Oil Filter" in Section 0B.
• Engine coolant – level, leakage	"Engine Coolant" in Section 0B.
• Fuel – level, leakage	"Fuel System" in Section 0B.
• Air cleaner element – dirt, clogging	"Air Cleaner Filter" in Section 0B.
• Battery – fluid level, corrosion of terminal	"Battery" in Section 6H.
• Water pump belt – tension damage	"Drive Belt" in Section 0B.
• Throttle cable – play (under warm engine), installation	"Accelerator Cable Adjustment" in Section 6E2.
• Vacuum hoses of air intake system – disconnection, looseness, deterioration, bend	"Evaporative Emission Control System Inspection" in Section 6E2.
• Connectors of electric wire harness – disconnection, friction	
• Fuses – burning	
• Parts – installation, bolt – looseness	
• Parts – deformation	
• Other parts that can be checked visually	
Also check the following items at engine start, if possible	
• Malfunction indicator lamp – Operation	"Malfunction Indicator Lamp (MIL) Check" in this section.
• Charge warning lamp – Operation	"Charging Indicator Lamp Operation" in Section 6H.
• Engine oil pressure warning lamp – Operation	"Oil Pressure Switch" in Section 8.
• Engine coolant temp. meter – Operation	"Engine Coolant Temperature (ECT) Sensor Inspection" in Section 6E2.
• Fuel level meter – Operation	"Inspection" in "Fuel Level Sensor" in Section 8.
• Tachometer – Operation	
• Abnormal air being inhaled from air intake system	
• Exhaust system – leakage of exhaust gas, noise	"Exhaust System" in Section 0B.
• Other parts that can be checked visually	

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Engine Basic Inspection

This check is very important for troubleshooting when ECM has detected no DTC and no abnormality has been found in visual inspection.
Follow the flow table carefully.

Step	Action	Yes	No
1	Was “ENGINE DIAG. FLOW TABLE” performed?	Go to Step 2.	Go to “Engine and Emission Control System Check” in this section.
2	Check battery voltage. Is it 11 V or more?	Go to Step 3.	Charge or replace battery.
3	Is engine cranked?	Go to Step 4.	Go to “DIAGNOSIS” in Section 6G.
4	Does engine start?	Go to Step 5.	Go to Step 7.
5	Check idle speed as follows: 1) Warm up engine to normal operating temp. 2) Shift transmission to neutral position for M/T (“P” position for A/T). 3) All of electrical loads are switched off. 4) Check engine idle speed with scan tool. See Fig. 1. Is it 650 – 750 r/min (700 – 800 r/min. for A/T vehicle)?	Go to Step 6.	Go to “Engine Symptom Diagnosis” in this section.
6	Check ignition timing as follows: 1) When SUZUKI scan tool is not available, disconnect scan tool from DLC and connect test switch terminal of monitor connector to ground. See Fig. 2. When using SUZUKI scan tool, select “MISC” mode on SUZUKI scan tool and fix ignition timing to initial one. See Fig. 3. 2) Using timing light (1), check initial ignition timing. See Fig. 4. Is it 5° ± 3° BTDC at specified idle speed?	Go to “Engine Symptom Diagnosis” in this section.	Check ignition control related parts referring to “Ignition Timing Inspection” in Section 6F1.
7	Is immobilizer control system equipped?	Go to Step 8.	Go to Step 9.
8	Check immobilizer system malfunction as follows. 1) Check immobilizer indicator lamp or MIL (malfunction indicator lamp) for flashing. Is it flashing when ignition switch is turned to ON position?	Go to “DTC Check” in Section 8G.	Go to Step 9.
9	Check fuel supply as follows: 1) Check to make sure that enough fuel is filled in fuel tank. 2) Turn ON ignition switch for 2 seconds and then OFF. See Fig. 5. Is fuel pressure felt from fuel feed hose (1) when ignition switch is turned ON?	Go to Step 11.	Go to Step 10.

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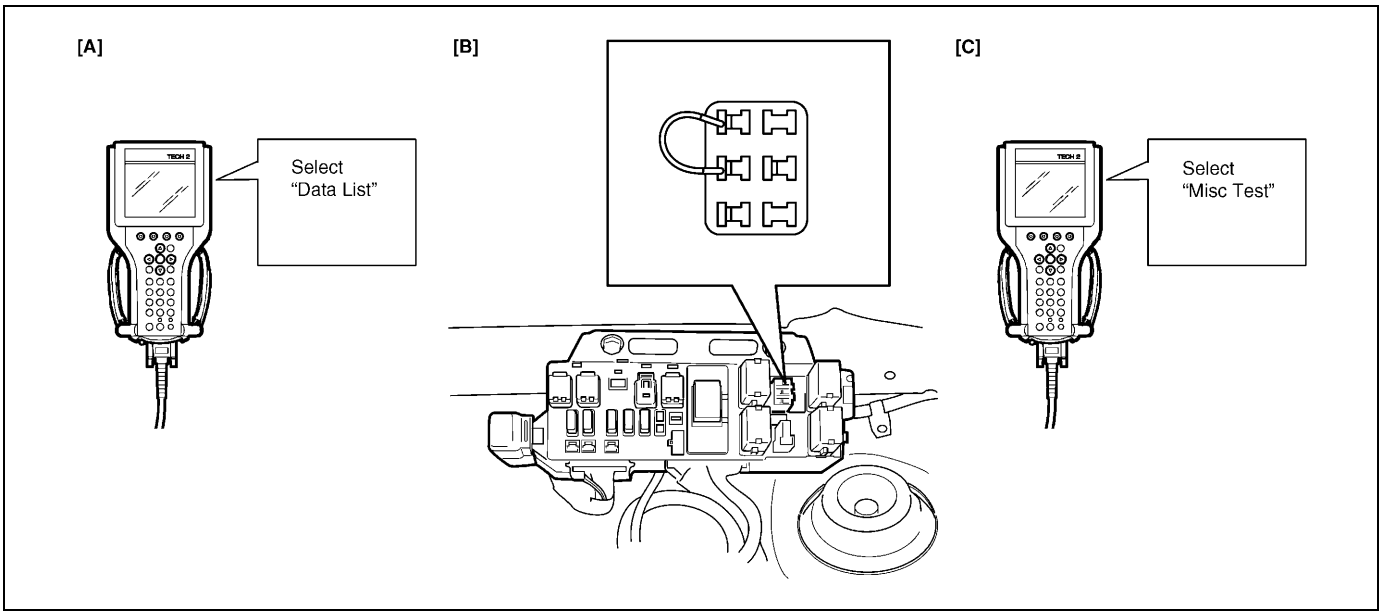
Step	Action	Yes	No
10	Check fuel pump for operating. Was fuel pump operating sound heard from fuel filler for about 10 seconds after ignition switch ON and stop?	Go to “Table B-3 Fuel Pressure Check” in this section.	Go to “Table B-2 Fuel Pump and Its Circuit Check” in this section.
11	Check ignition spark as follows: 1) Disconnect injector couplers. 2) Remove spark plugs and connect them to high-tension cords or ignition coils. 3) Ground spark plugs. 4) Crank engine and check if each spark plug sparks. Is it in good condition?	Go to Step 12.	Go to “Ignition Spark Test” in Section 6F2.
12	Check fuel injector for operation as follows: 1) Install spark plugs and connect injector connectors. 2) Using sound scope (1), check operating sound of each injector (2) when cranking engine. See Fig. 5. Was injector operating sound heard from all injectors?	Go to “Engine Symptom Diagnosis” in this section.	Go to “Table B-1 Fuel Injector Circuit Check” in this section.



[A]: Fig. 1 for Step 5
[B]: Fig. 2 for Step 6
[C]: Fig. 3 for Step 6

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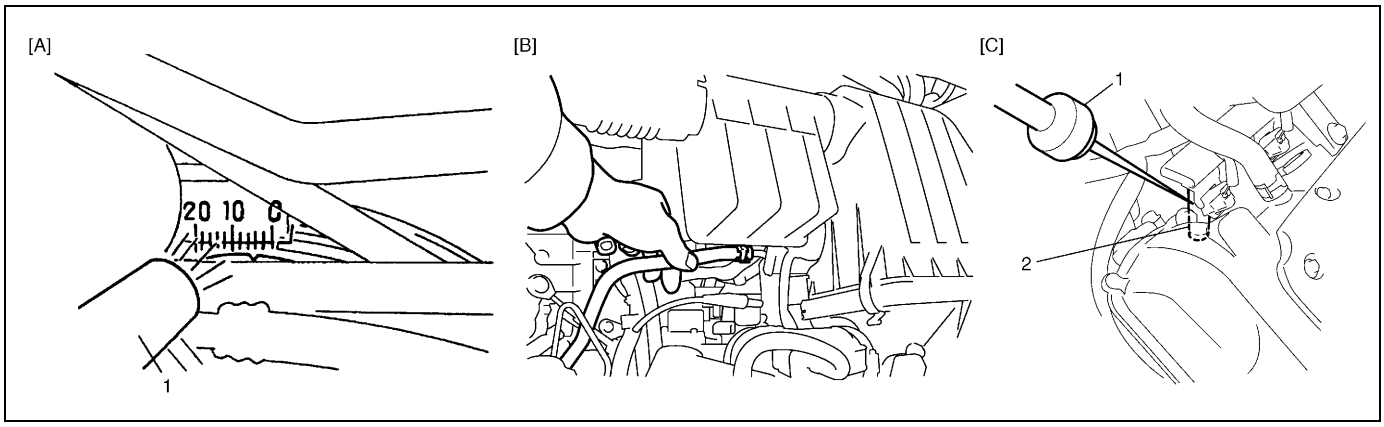

[A]: Fig. 4 for Step 6
[B]: Fig. 5 for Step 9
[C]: Fig. 6 for Step 12

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Engine Symptom Diagnosis

Perform troubleshooting referring to following table when ECM has detected no DTC and no abnormality has been found in visual inspection and engine basic inspection previously.

Condition	Possible Cause	Reference Item
Hard Starting (Engine cranks OK)	Faulty spark plug	"Spark Plugs" in Section 6F1.
	Leaky high-tension cord	"High-tension Cords" in Section 6F1.
	Loose connection or disconnection of high-tension cords or lead wires	"High-tension Cords" in Section 6F1.
	Faulty ignition coil	"Ignition Coil Assembly (Including Igni-tor)" in Section 6F1.
	Dirty or clogged fuel hose or pipe	"Table B-3 Fuel Pressure Check" in this section.
	Malfunctioning fuel pump	"Table B-3 Fuel Pressure Check" in this section.
	Air inhaling from intake manifold gasket or throttle body gasket	
	Faulty idle air control system	"Table B-4 Idle Air Control System Check" in this section.
	Faulty ECT sensor or MAP sensor	"ECT Sensor Inspection" or "Manifold Absolute Pressure (MAP) Sensor Inspection" in Section 6E2.
	Faulty ECM	
	Low compression	"Compression Check" in Section 6A1.
	Poor spark plug tightening or faulty gasket	"Spark Plugs" in Section 6F1.
	Compression leak from valve seat	"Valves and Cylinder Head Inspection" in Section 6A1.
	Sticky valve stem	"Valves and Cylinder Head Inspection" in Section 6A1.
	Weak or damaged valve springs	"Valves and Cylinder Head Inspection" in Section 6A1.
	Compression leak at cylinder head gasket	"Valves and Cylinder Head Inspection" in Section 6A1.
	Sticking or damaged piston ring	"Pistons, Piston rings, Connecting Rods and Cylinders Inspection" in Sec-tion 6A1.
	Worn piston, ring or cylinder	"Pistons, Piston rings, Connecting Rods and Cylinders Inspection" in Sec-tion 6A1.
	Malfunctioning PCV valve	"PCV System Inspection" in Section 6E2.
	VVT system out of order	"Oil Control Valve Inspection" in Section 6E2.

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Condition	Possible Cause	Reference Item
Low oil pressure	Improper oil viscosity	"Engine Oil and Oil Filter" in Section 0B.
	Malfunctioning oil pressure switch	"Oil Pressure Switch" in Section 8.
	Clogged oil strainer	"Oil Pan and Oil Pump Strainer" in Section 6A1.
	Functional deterioration of oil pump	"Oil Pan and Oil Pump Strainer" in Section 6A1.
	Worn oil pump relief valve	"Oil Pan and Oil Pump Strainer" in Section 6A1.
	Excessive clearance in various sliding parts	
Engine noise **Note: Before checking mechanical noise, make sure that:** **Specified spark plug is used.** **Specified fuel is used.**	Improper valve lash	"Valves and Cylinder Head Inspection" in Section 6A1.
	Worn valve stem and guide	"Valves and Cylinder Head Inspection" in Section 6A1.
	Weak or broken valve spring	"Valves and Cylinder Head Inspection" in Section 6A1.
	Warped or bent valve	"Valves and Cylinder Head Inspection" in Section 6A1.
	Worn piston, ring and cylinder bore	"Pistons, Piston rings, Connecting Rods and Cylinders Inspection" in Section 6A1.
	Worn rod bearing	"Pistons, Piston rings, Connecting Rods and Cylinders Inspection" in Section 6A1.
	Worn crank pin	"Pistons, Piston rings, Connecting Rods and Cylinders Inspection" in Section 6A1.
	Loose connecting rod nuts	"Pistons, Piston rings, Connecting Rods and Cylinders Inspection" in Section 6A1.
	Low oil pressure	"Low Oil Pressure" in this table.
	Worn bearing	"Main bearings, Crankshaft and Cylinder Block Inspection" in Section 6A1.
	Worn crankshaft journal	"Main bearings, Crankshaft and Cylinder Block Inspection" in Section 6A1.
	Loose bearing cap bolts	"Main bearings, Crankshaft and Cylinder Block Inspection" in Section 6A1.
	Excessive crankshaft thrust play	"Main bearings, Crankshaft and Cylinder Block Inspection" in Section 6A1.

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Condition	Possible Cause	Reference Item
Overheating	Inoperative thermostat	"Inspection" in "Thermostat" in Section 6B.
	Poor water pump performance	"Water Pump Inspection" in Section 6B.
	Clogged or leaky radiator	"Inspection" in "Radiator" in Section 6B.
	Improper engine oil grade	"Engine Oil and Oil Filter" in Section 0B.
	Clogged oil filter or oil strainer	"Oil Pressure Check" in Section 6A1.
	Poor oil pump performance	"Oil Pressure Check" in Section 6A1.
	Faulty radiator fan control system	"Table B-7 Radiator Fan Control System Check" in this section.
	Dragging brakes	"Diagnosis Table" in Section 5.
	Slipping clutch	"Diagnosis Table" in Section 7C.
	Blown cylinder head gasket	"Valves and Cylinder Head Inspection" in Section 6A1.
Poor gasoline mileage	Leaks or loose connection of high-tension cord	"High-tension Cords" in Section 6F2.
	Faulty spark plug (improper gap, heavy deposits and burned electrodes, etc.)	"Spark Plugs" in Section 6F1.
	Malfunctioning EGR valve (if equipped)	"EGR Valve Inspection" Section 6E2.
	High idle speed	"Improper Engine Idling or Engine Fails to Idle" in this table.
	Poor performance of TP sensor, ECT sensor or MAP sensor	"TP Sensor On-Vehicle Inspection", "ECT Sensor Inspection" or "Manifold Absolute Pressure (MAP) Sensor Inspection" in Section 6E2.
	Faulty fuel injector(s)	"Table B-1 Fuel Injector Circuit Check" in this section.
	Faulty ECM	
	Low Compression	"Low Compression" in this table.
	Poor valve seating	"Valves and Cylinder Head Inspection" in Section 6A1.
	Dragging brakes	"Diagnosis Table" in Section 5.
	Slipping clutch	"Diagnosis Table" in Section 7C.
	Thermostat out of order	"Inspection" in "Thermostat" in Section 6B.
	Improper tire pressure	"Replacement Tires" in Section 3F.
	VVT system out of order	"Oil Control Valve Inspection" in Section 6E2.

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Condition	Possible Cause	Reference Item
Excessive engine oil consumption	Blown cylinder head gasket	"Valves and Cylinder Head Inspection" in Section 6A1.
	Leaky camshaft oil seals	"Camshaft, Tappet and Shim" in Section 6A1.
	Sticky piston ring	"Pistons, Piston rings, Connecting Rods and Cylinders Inspection" in Section 6A1.
	Worn piston and cylinder	"Pistons, Piston rings, Connecting Rods and Cylinders Inspection" in Section 6A1.
	Worn piston ring groove and ring	"Pistons, Piston rings, Connecting Rods and Cylinders Inspection" in Section 6A1.
	Improper location of piston ring gap	"Pistons, Piston rings, Connecting Rods and Cylinders Disassembly and Assembly" in Section 6A1.
	Worn or damaged valve stem seal	"Valves and Cylinder Head Disassembly and Assembly in Section 6A1.
	Worn valve stem	"Valves and Cylinder Head Inspection" in Section 6A1.
Engine hesitates (Momentary lack of response as accelerator is depressed. Can occur at all vehicle speeds. Usually most severe when first trying to make vehicle move, as from a stop sign.)	Spark plug faulty or plug gap out of adjustment	"Spark Plugs" in Section 6F1.
	Leaky high-tension cord	"High-tension Cords" in Section 6F1.
	Fuel pressure out of specification	"Table B-3 Fuel Pressure Check" in this section.
	Malfunctioning EGR valve (if equipped)	"EGR Valve Inspection" in Section 6E2.
	Poor performance of TP sensor, ECT sensor or MAP sensor	"TP Sensor On-Vehicle Inspection", "ECT Sensor Inspection" or "Manifold Absolute Pressure (MAP) Sensor Inspection" in Section 6E2.
	Faulty fuel injector	"Table B-1 Fuel Injector Circuit Check" in this section.
	Faulty ECM	
	Engine overheating	"Overheating" in this table.
	Low compression	"Low Compression" in this table.
	VVT system out of order	"Oil Control Valve Inspection" in Section 6E2.

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Condition	Possible Cause	Reference Item
Surge (Engine power variation under steady throttle or cruise. Feels like vehicle speeds up and down with no change in accelerator pedal.)	Leaky or loosely connected high-tension cord	"High-tension Cords" in Section 6F1.
	Faulty spark plug (excess carbon deposits, improper gap, and burned electrodes, etc.)	"Spark Plugs" in Section 6F1.
	Variable fuel pressure	"Table B-3 Fuel Pressure Check" in this section.
	Kinky or damaged fuel hose and lines	
	Faulty fuel pump (clogged fuel filter)	
	Malfunctioning EGR valve (if equipped)	"EGR Valve Inspection" in Section 6E2.
	Poor performance of MAP sensor	"Manifold Absolute Pressure (MAP) Sensor Inspection" in Section 6E2.
	Faulty fuel injector	"Table B-1 Fuel Injector Circuit" in this section.
	Faulty ECM	
Excessive detonation (Engine makes continuously sharp metallic knocks that change with throttle opening. Sounds like pop corn popping.)	Faulty spark plug	"Spark Plugs" in Section 6F1.
	Loose connection of high-tension cord	"High-tension Cords" in Section 6F1.
	Engine overheating	"Overheating" in this table.
	Clogged fuel filter (faulty fuel pump) or fuel lines	"Table B-1 Fuel Injector Circuit Check" or "Table B-2 Fuel Pump and Its Circuit Check" in this section.
	Air inhaling from intake manifold or throttle body O-ring	
	Malfunctioning EGR valve (if equipped)	"EGR Valve Inspection" in Section 6E2.
	Poor performance of knock sensor, ECT sensor or MAP sensor	"DTC P0325 Knock Sensor Circuit Malfunction" in this section, "ECT Sensor Inspection" or "Manifold Absolute Pressure (MAP) Sensor Inspection" in Section 6E2.
	Faulty fuel injector(s)	"Table B-1 Fuel Injector Circuit Check" in this section.
	Faulty ECM	
	Excessive combustion chamber deposits	"Pistons, Piston rings, Connecting Rods and Cylinders Inspection" in Section 6A1.
	VVT system out of order	"Oil Control Valve Inspection" in Section 6E2.

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Condition	Possible Cause	Reference Item
Engine has no power	Faulty spark plug	“Spark Plugs” in Section 6F1.
	Faulty ignition coil with ignitor	“Ignition Coil Assembly (Including Ignitor)” in Section 6F1.
	Leaks, loose connection or disconnection of high-tension cord	“High-tension Cords” in Section 6F1.
	Faulty knock sensor	“DTC P0325 Knock Sensor Circuit Malfunction” in this section.
	Clogged fuel hose or pipe	“Table B-3 Fuel Pressure Check” in this section.
	Malfunctioning fuel pump	“Table B-2 Fuel Pump and Its Circuit Check” in this section.
	Air inhaling from intake manifold gasket or throttle body gasket	
	Engine overheating	“Overheating” in this table.
	Malfunctioning EGR valve (if equipped)	“EGR Valve Inspection” in Section 6E2.
	Maladjusted accelerator cable play	“Accelerator cable Adjustment” in Section 6E2.
	Poor performance of TP sensor, ECT sensor or MAP sensor	“TP Sensor On-Vehicle Inspection”, “ECT Sensor Inspection” or “Manifold Absolute Pressure (MAP)” in Section 6E2.
	Faulty fuel injector(s)	“Table B-1 Fuel Injector Circuit Check” in this section.
	Faulty ECM	
	Dragging brakes	“Diagnosis Table” in Section 5.
	Slipping clutch	“Diagnosis Table” in Section 7C.
	Low compression	“Compression Check” in Section 6A2.
	VVT system out of order	“Oil Control Valve Inspection” in Section 6E2.

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Condition	Possible Cause	Reference Item
Improper engine idling or engine fails to idle	Faulty spark plug	“Spark Plugs” in Section 6F1.
	Leaky or disconnected high-tension cord	“High-tension Cords” in Section 6F1.
	Faulty ignition coil with ignitor	“Ignition Coil Assembly (Including Ignitor)” in Section 6F1.
	Fuel pressure out of specification	“Table B-3 Fuel Pressure Check” in this section.
	Leaky manifold, throttle body, or cylinder head gasket	
	Faulty idle air control system	“Table B-4 Idle Air Control System Check” in this section.
	Faulty evaporative emission control system	“Evaporative Emission Control System Inspection” in Section 6E2.
	Faulty EGR system (if equipped)	“EGR Valve Inspection” in Section 6E2.
	Faulty fuel injector(s)	“Table B-1 Fuel Injector Circuit Check” in this section.
	Poor performance of ECT sensor, TP sensor or MAP sensor	“TP Sensor On-Vehicle Inspection”, “ECT Sensor Inspection” or “Manifold Absolute Pressure (MAP) Sensor Inspection” in Section 6E2.
	Faulty ECM	
	Loose connection or disconnection of vacuum hoses	
	Malfunctioning PCV valve	“PCV System Inspection” in Section 6E2.
	Engine overheating	“Overheating” in this section.
	Low compression	“Compression Check” in Section 6A1.
	VVT system out of order	“Oil Control Valve Inspection” in Section 6E2.

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Condition	Possible Cause	Reference Item
Excessive hydrocarbon (HC) emission or carbon monoxide (CO)	Faulty spark plug	"Spark Plugs" in Section 6F1.
	Leaky or disconnected high-tension cord	"High-tension Cords" in Section 6F1.
	Faulty ignition coil with ignitor	"Ignition Coil Assembly (Including Ignitor)" in Section 6F1.
	Low compression	"Compression Check" in Section 6A1.
	Lead contamination of three way catalytic converter	Check for absence of filler neck restrictor.
	Faulty evaporative emission control system	"Evaporative Emission Control System Inspection" in Section 6E2.
	Fuel pressure out of specification	"Table B-3 Fuel Pressure Check" in this section.
	Closed loop system (A/F feed back compensation) fails • Faulty TP sensor • Poor performance of ECT sensor or MAP sensor	 "TP Sensor On-Vehicle Inspection" in Section 6E2. "ECT Sensor Inspection" or "Manifold Absolute Pressure (MAP) Sensor Inspection" in Section 6E2.
	Faulty injector(s)	"Table B-1 Fuel Injector Circuit Check" in this section.
	Faulty ECM	
	Engine not at normal operating temperature	
	Clogged air cleaner	
	Vacuum leaks	
	VVT system out of order	"Oil Control Valve Inspection" in Section 6E2.
Excessive nitrogen oxides (NOx) emission	Improper ignition timing	"Ignition Timing" in Section 6F1.
	Lead contamination of catalytic converter	Check for absence of filler neck restrictor.
	Faulty EGR system (if equipped)	"EGR Valve Inspection" in Section 6E2.
	Fuel pressure out of specification	"Table B-3 Fuel Pressure Check" in this section.
	Closed loop system (A/F feed back compensation) fails • Faulty TP sensor • Poor performance of ECT sensor or MAP sensor	 "TP Sensor On-Vehicle Inspection" in Section 6E2. "ECT Sensor Inspection" or "Manifold Absolute Pressure (MAP) Sensor Inspection" in Section 6E2.
	Faulty injector(s)	"Table B-1 Fuel Injector Circuit Check" in this section.
	Faulty ECM	
	VVT system out of order	"Oil Control Valve Inspection" in Section 6E2.

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Scan Tool Data

As the data values given below are standard values estimated on the basis of values obtained from the normally operating vehicles by using a scan tool, use them as reference values. Even when the vehicle is in good condition, there may be cases where the checked value does not fall within each specified data range. Therefore, judgment as abnormal should not be made by checking with these data alone.
Also, conditions in the table below that can be checked by the scan tool are those detected by ECM and output from ECM as commands and there may be cases where the engine or actuator is not operating (in the condition) as indicated by the scan tool. Be sure to use the timing light to check the ignition timing.

NOTE:

- **With the generic scan tool, only star (∗) marked data in the table below can be read.**
- **The triangle (△) marked data in the table below can not be read for vehicle without immobilizer indicator lamp.**
- **When checking the data with the engine running at idle or racing, be sure to shift M/T gear to the neutral gear position and pull the parking brake fully. Also, if nothing or "no load" is indicated, turn OFF A/C, all electric loads, P/S and all the other necessary switches.**

SCAN TOOL DATA			VEHICLE CONDITION		NORMAL CONDITION/ REFERENCE VALUES
	∗	COOLANT TEMP (ENGINE COOLANT TEMP.)	At specified idle speed after warming up		80 – 100°C, 176 – 212°F
	∗	INTAKE AIR TEMP	At specified idle speed after warming up		–5°C (23°F) + environmental temp. to 40°C (104°F) + environmental temp.
	∗	ENGINE SPEED	At idling with no load after warming up		Desired idle speed ±50 RPM
		VVT GAP (TARGET-ACTUAL POSITION)	At specified idle speed after warming up		0 – 3°
△		INJ PULSE WIDTH (FUEL INJECTION PULSE WIDTH)	At specified idle speed with no load after warming up		2.0 – 4.0 msec.
			At 2500 r/min with no load after warming up		2.0 – 3.6 msec.
		TP SENSOR VOLT (THROTTLE POSITION SENSOR OUTPUT VOLTAGE)	Ignition switch ON/warmed up engine stopped	Accelerator pedal released	0.5 – 1.0 V
				Accelerator pedal depressed fully	Less than 4.8 V
		DESIRED IDLE (DESIRED IDLE SPEED)	At idling with radiator cooling fan stopped and all electrical parts turned OFF after warming up, M/T at neutral		700 RPM
		IAC FLOW DUTY (IDLE AIR CONTROL FLOW DUTY)	At idling with no load after warming up		5 – 55%
	∗	SHORT FT B1 (SHORT TERM FUEL TRIM)	At specified idle speed after warming up		– 20 – +20%
	∗	LONG FT B1 (LONG TERM FUEL TRIM)	At specified idle speed after warming up		– 20 – +20%
		TOTAL FUEL TRIM	At specified idle speed after warming up		– 35 – +35%

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SCAN TOOL DATA			VEHICLE CONDITION		NORMAL CONDITION/ REFERENCE VALUES
	✱	CALC LOAD (CALCULATED LOAD VALUE)	At specified idle speed with no load after warming up		0 – 10%
			At 2500 r/min with no load after warming up		0 – 10%
	✱	THROTTLE POSITION (ABSOLUTE THROTTLE POSITION)	Ignition switch ON/warmed up engine stopped	Accelerator pedal released	0 – 5%
				Accelerator pedal depressed fully	90 – 100%
	✱	O2S B1 S1 (HEATED OXYGEN SENSOR–1)	At specified idle speed after warming up		0.1 – 0.95 V
Δ	✱	O2S B1 S2 (HEATED OXYGEN SENSOR–2)	When engine is running at 2000 r/min. for 3 min or longer after warming up.		0.1 – 0.95 V
Δ		FUEL SYSTEM B1 (FUEL SYSTEM STATUS)	At specified idle speed after warming up		CLOSED (closed loop)
	✱	MAP (INTAKE MANIFOLD ABSOLUTE PRESSURE)	At specified idle speed with no load after warming up		24 – 38 kPa 180 – 285 mmHg
		BAROMETRIC PRES	–		Display the barometric pressure
		STEP EGR FLOW DUTY	At specified idle speed after warming up		0%
		FUEL CUT	When engine is at fuel cut condition		ON
			Other than fuel cut condition		OFF
		CLOSED THROTTLE POS (CLOSED THROTTLE POSITION)	Throttle valve at idle position		ON
			Throttle valve opens larger than idle position		OFF
		CANIST PRG DUTY (EVAP CANISTER PURGE FLOW DUTY)	At specified idle speed after warming up		0%
	✱	IGNITION ADVANCE (IGNITION TIMING ADVANCE FOR NO.1 CYLINDER)	At specified idle speed with no load after warming up		3 – 13° BTDC
		BATTERY VOLTAGE	Ignition switch ON/engine stop		10 – 14 V
		FUEL PUMP	Within 3 seconds after ignition switch ON or engine running		ON
			Engine stop at ignition switch ON		OFF
		ELECTRIC LOAD	Ignition switch ON/Headlight, small light, all turned OFF		OFF
			Ignition switch ON/Headlight, small light, turned ON		ON
		BRAKE SWITCH	Ignition switch ON	Brake pedal is released	OFF
				Brake pedal is depressed	ON
		RADIATOR FAN (RADIATOR FAN CONTROL RELAY)	Ignition switch ON	Engine coolant temp.: Lower than 92.5°C (198.5°F)	OFF
				Engine coolant temp.: 97.5°C (208°F) or higher	ON

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SCAN TOOL DATA			VEHICLE CONDITION		NORMAL CONDITION/ REFERENCE VALUES
		BLOWER FAN	Ignition switch ON	Blower fan switch: 2nd speed position or more	ON
				Blower fan switch: under 2nd speed position	OFF
		A/C SWITCH (if equipped with A/C)	Engine running after warming up, A/C not operating		OFF
			Engine running after warming up, A/C operating		ON
		A/C MAG CLUTCH (if equipped with A/C)	Engine running	A/C switch and blower motor switch turned ON	ON
				A/C switch and blower motor switch turned OFF	OFF
Δ		A/C COND FAN (if equipped with A/C)	Engine running	Blower motor switch and A/C switch turned ON	ON
				Blower motor switch and/ or A/C switch turned OFF	OFF
		VEHICLE SPEED	At stop		0 km/h

Scan Tool Data Definitions

COOLANT TEMP (ENGINE COOLANT TEMPERATURE, °C, °F)
It is detected by engine coolant temp. sensor.

INTAKE AIR TEMP. (°C, °F)
It is detected by intake air temp. sensor.

ENGINE SPEED (rpm)
It is computed by reference pulses from the camshaft position sensor.

TOTAL FUEL TRIM B1 (%)
The value of Total Fuel Trim is obtained by calculating based on values of short Term Fuel Trim and Long Term Fuel Trim. This value indicates how much correction is necessary to keep the air/fuel mixture stoichiometrical.

INJ PULSE WIDTH (FUEL INJECTION PULSE WIDTH, msec.)
This parameter indicates time of the injector drive (valve opening) pulse which is output from ECM (but injector drive time of NO.1 cylinder for multiport fuel injection).

TP SENSOR VOLT (THROTTLE POSITION SENSOR OUTPUT VOLTAGE, V)
The Throttle Position Sensor reading provides throttle valve opening information in the form of voltage.

DESIRED IDLE (DESIRED IDLE SPEED, rpm)
The Desired Idle Speed is an ECM internal parameter which indicates the ECM requested idle. If the engine is not running, this number is not valid.

IAC FLOW DUTY (IDLE AIR (SPEED) CONTROL DUTY, %)
This parameter indicates current flow time rate within a certain set cycle of IAC valve (valve opening rate) which controls the amount of bypass air (idle speed).

SHORT FT B1 (SHORT TERM FUEL TRIM, %)
Short term fuel trim value represents short term corrections to the air/fuel mixture computation. A value of 0 indicates no correction, a value greater than 0 means an enrichment correction, and a value less than 0 implies an enleanment correction.

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LONG FT B1 (LONG TERM FUEL TRIM, %)
Long term fuel trim value represents long term corrections to the air/fuel mixture computation. A value of 0 indicates no correction, a value greater than 0 means an enrichment correction, and a value less than 0 means an enrichment correction, and a value less than 0 implies an enleanment correction.

VVT GAP [TARGET-ACTUAL POSITION] (°)
It is calculated using the formula: target valve timing advance – actual valve timing advance.

CALC LOAD (CALCULATED LOAD VALUE, %)
Engine load displayed as a percentage of maximum possible load. Value is calculated mathematically using the formula: actual (current) intake air volume ÷ maximum possible intake air volume x 100%

THROTTLE POS (ABSOLUTE THROTTLE POSITION, %)
When throttle position sensor is fully closed position, throttle opening is indicated as 0% and 90 – 100% full open position.

O2S SENSOR B1 S1 (HEATED OXYGEN SENSOR–1, V)
It indicates output voltage of HO2S–1 installed on exhaust manifold (pre-catalyst).

O2S SENSOR B1 S2 (HEATED OXYGEN SENSOR–2, V)
It indicates output voltage of HO2S–2 installed on exhaust pipe (post-catalyst). It is used to detect catalyst deterioration.

FUEL SYSTEM (FUEL SYSTEM STATUS)
Air/fuel ratio feedback loop status displayed as one of the followings.
OPEN: Open loop-has not yet satisfied conditions to go closed loop.
CLOSED: Closed loop-using oxygen sensor(s) as feedback for fuel control.
OPEN-DRIVE COND: Open loop due to driving conditions (Power enrichment, etc.).
OPEN SYS FAULT: Open loop due to detected system fault.
CLOSED-ONE O2S: Closed loop, but fault with at least one oxygen sensor-may be using single oxygen sensor for fuel control.

MAP (MANIFOLD ABSOLUTE PRESSURE, mmHg, kPa)
This value indicates how much correction is necessary to keep the air/fuel mixture stoichiometrical.
It is detected by manifold absolute pressure sensor.

BAROMETRIC PRESS (kPa, inHg)
This parameter represents a measurement of barometric air pressure and is used for altitude correction of the fuel injection quantity and IAC valve control.

STEP EGR FLOW DUTY (%)
This parameter indicates opening rate of EGR valve which controls the amount of EGR flow.

FUEL CUT (ON/OFF)
ON: Fuel being cut (output signal to injector is stopped)
OFF: Fuel not being cut

CLOSED THROTTLE POSITION (ON/OFF)
This parameter will read ON when throttle valve is fully closed, or OFF when the throttle is not fully closed.

CANIST PURGE DUTY (EVAP CANISTER PURGE FLOW DUTY, %)
This parameter indicates valve ON (valve open) time rate within a certain set cycle of EVAP canister purge valve which controls the amount of EVAP purge.

IGNITION ADVANCE (IGNITION TIMING ADVANCE FOR NO.1 CYLINDER, °)
Ignition timing of NO.1 cylinder is commanded by ECM. The actual ignition timing should be checked by using the timing light.

BATTERY VOLTAGE (V)

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This parameter indicates battery positive voltage inputted from main relay to ECM.

FUEL PUMP (ON/OFF)
ON is displayed when the ECM activates the fuel pump via the fuel pump relay switch.

ELECTRIC LOAD (ON/OFF)
ON: Headlight or small light ON signal inputted.
OFF: Above electric loads all turned OFF.

BRAKE SW (ON/OFF)
This parameter indicates the state of the brake switch.

RADIATOR FAN (RADIATOR FAN CONTROL RELAY, ON/OFF)
ON: Command for radiator fan control relay operation being output.
OFF: Command for relay operation not being output.

BLOWER FAN (ON/OFF)
This parameter indicates the state of the blower fan motor switch.

A/C SWITCH (ON/OFF)
ON: Command for A/C operation being output from ECM to A/C amplifier.
OFF: Command for A/C operation not being output.

A/C MAG SWITCH (A/C COMPRESSOR RELAY, ON/OFF)
This parameter indicates the state of the A/C switch.

A/C COND FAN (ON/OFF)
This parameter indicates the state of the A/C Condenser Fan control signal.

VEHICLE SPEED (km/h)
It is computed based on pulse signals from vehicle speed sensor.

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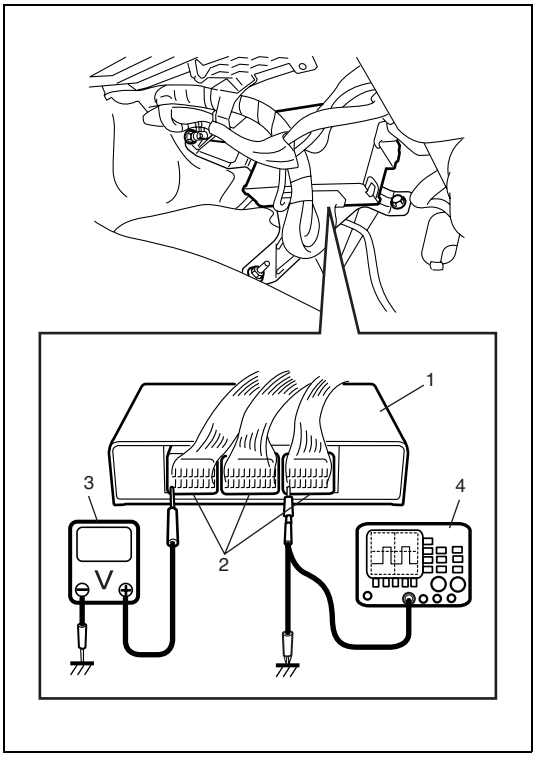
Inspection of ECM and Its Circuits

ECM and its circuits can be checked at ECM wiring couplers by measuring voltage, pulse signal and resistance.

CAUTION:
ECM cannot be checked by itself. It is strictly prohibited to connect voltmeter or ohmmeter to ECM with coupler disconnected from it.

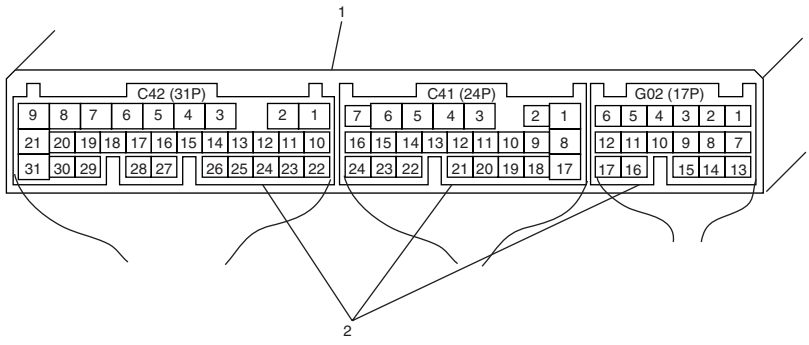
Voltage check



1) Remove ECM (1) from vehicle body referring to "Engine Control Module Removal and Installation" in Section 6E2.
2) Check voltage and/or pulse signal at each terminal of couplers (2) connected, using voltmeter (3) and oscilloscope (4).

NOTE:

- **As each terminal voltage is affected by the battery voltage, confirm that it is 11 V or more when ignition switch is turned ON.**
- **Voltage with asterisk (*) cannot be measured by voltmeter because it is pulse signal.**
  Check it with oscilloscope if necessary.



1. ECM
2. ECM couplers (Viewed from harness side)

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ECM Voltage Values

Terminal number		Wire color	Circuit	Normal Voltage	Condition
C42	1	BLK/ORN	Ground for ECM	Below 0.3 V	Ignition switch turned ON
	2	BLK	Ground for drive circuit	Below 0.3 V	Ignition switch turned ON
	3	BLK/ORN	Ground for drive circuit	Below 0.3 V	Ignition switch turned ON
	4	BLU/BLK	EVAP canister purge valve output	10 – 14 V	Ignition switch turned ON with engine stop
				* 0 – 0.6 V ↑ ↓ 10 – 14 V (Reference waveform No.24)	Engine running. and vehicle running over 40 km/h, 25 ml/h (Output signal is 10 Hz duty pulse. Duty ratio varies depending on vehicle condition.)
	5	–	–	–	–
	6	GRN/RED	IAC valve output	0 – 1V	Ignition switch turned ON
				* 0 – 2 V ↑ ↓ 8 – 14 V (Reference waveform No.4)	Ignition switch is turned to ST (cranking) position. (Output signal is active low duty pulse. Pulse generated times depending on vehicle condition)
	7	RED/BLU	Heater output of heated oxygen sensor–1	10 – 14 V	Ignition switch turned ON
				* 0 – 2 V ↑ ↓ 13.5 – 14.8 V (Reference waveform No.2 and No.3)	Engine running at idling with after warming up. (Output signal is active low duty pulse. Duty ratio varies depending on engine condition.)
	8	BLU/ORN	Fuel injector No.4 output	10 – 14 V	Ignition switch turned ON
				* 0 – 0.6 V ↑ ↓ 10 – 14 V (Reference waveform No.10, No.11 and No.26)	Engine running (Output signal is active low pulse. Pulse frequency varies depending on engine speed.)
	9	BLU/YEL	Fuel injector No.1 output	10 – 14 V	Ignition switch turned ON
				* 0 – 0.6 V ↑ ↓ 10 – 14 V (Reference waveform No.10, No.14, No.25 and No.26)	Engine running (Output signal is active low pulse. Pulse frequency varies depending on engine speed.)
	10	ORN	Ground for sensors	–	–

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Terminal number		Wire color	Circuit	Normal Voltage	Condition
C42	11	RED/YEL	Reference (classified cylinder) signal for CMP sensor	10 – 14 V	Ignition switch turned on
				* 0 – 0.6 V ↑ ↓ 4 – 5 V (Reference waveform No.17)	Engine running at idling with after warming up (Sensor signal is pulse. Pulse frequency varies depending on engine speed.) (6 pulses are generated par 1camshaft revolution)
	12	GRN	Ground of ECM for shield wire	Below 0.3 V	Ignition switch turned ON
	13	WHT	Oxygen signal of heated oxygen sensor–1	0.5 – 1.5 V	Ignition switch turned ON
				* Deflects between over 0.5 V and under 0.45 V (Reference waveform No.2 and No.3)	While engine running at 2,000 r/min. for 1min. or longer after warmed up
	14	LT GRN	Engine coolant temp. (ECT) sensor signal	3.3 – 3.6 V	Ignition switch turned ON, ECT at 0°C, 32°F
				1.1 – 1.5 V	Ignition switch turned ON, ECT at 50°C, 122°F
				0.3 – 0.45 V	Ignition switch turned ON, ECT at 100°C, 212°F
	15	LT GRN/BLK	Intake air temperature signal	3.3 – 3.6 V	Ignition switch turned ON, IAT at 0°C, 32°F
				1.6 – 1.9 V	Ignition switch turned ON, IAT at 40°C, 104°F
				0.6 – 0.8 V	Ignition switch turned ON, IAT at 80°C, 176°F
	16	GRY/BLU	Throttle position (TP) sensor signal	0.5 – 1.0 V	Ignition switch turned ON and throttle valve at idle position with warmed engine
				3.4 – 4.7 V	Ignition switch turned ON and throttle valve at full open position
	17	WHT/RED	EGR valve (stepper motor coil 3) output	10 – 14 V	Ignition switch is turned ON
				* 0 – 2 V ↑ ↓ 8 – 14 V (Reference waveform No.5)	Ignition switch is turned to ST (cranking) position. (Output signal is active low duty pulse. Pulse generated times depending on vehicle condition)
	18	GRY	EGR valve (stepper motor coil 1) output	0 – 2V	Ignition switch turned ON
				* 0 – 2 V ↑ ↓ 8 – 14 V (Reference waveform No.5)	Ignition switch is turned to ST (cranking) position. (Output signal is active low duty pulse. Pulse generated times depending on vehicle condition)

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Terminal number		Wire color	Circuit	Normal Voltage	Condition
C42	19	GRN/WHT	Ignition coil No.2 and No.3 output	0 – 0.6 V	Ignition switch turned ON
				* 0 – 0.6 V ↑ ↓ 2 – 5V (Reference waveform No.6)	Engine running (Output signal is active high pulse. Pulse frequency varies depending on engine speed.)
	20	GRN/YEL	Ignition coil No.1 and No.4 output	0 – 0.6 V	Ignition switch turned ON
				* 0 – 0.6 V ↑ ↓ 2 – 5V (Reference waveform No.7 and No.25)	Engine running (Output signal is active high pulse. Pulse frequency varies depending on engine speed.)
	21	BLU/WHT	Fuel injector No.2 output	10 – 14 V	Ignition switch turned ON
				* 0 – 0.6 V ↑ ↓ 10 – 14 V (Reference waveform No.10, No.13 and No.26)	Engine running (Output signal is active low pulse. Pulse frequency varies depending on engine speed.)
	22	GRY/RED	Output of 5V power source for throttle position (TP) sensor and manifold absolute pressure (MAP) sensor	4.5 – 5.5 V	Ignition switch turned ON
	23	YEL/BLK	CKP sensor signal	0 – 1 V	Ignition switch turned ON,
				* 4.4 – 4.6 V ↑ ↓ 0.1 – 0.3 V (Reference waveform No.17)	Engine running at idling with after warming up. (Sensor signal is pulse. Pulse frequency varies depending on engine speed.) (31(34-4) pulses are generated par 1crankshaft revolution)
	24	–	–	–	–
	25	RED	Knock sensor signal	* 2 – 3 V (Reference waveform No.15 and No.16)	Ignition switch turned ON
					Engine running at idling with after warming up
	26	RED/WHT	Manifold absolute pressure (MAP) sensor signal	* About 4 V (Reference waveform No.18)	Ignition switch turned ON with barometric pressure at 100kPa, 760mmHg while engine is stopped
				* 0.4 – 1.8 V (Reference waveform No.19)	While specified idle speed after warming up with barometric pressure at 100kPa, 760mmHg
	27	–	–	–	–

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Terminal number		Wire color	Circuit	Normal Voltage	Condition
C42	28	BRN/YEL	EGR valve (stepper motor coil 4) output	0 – 2V	Ignition switch turned ON
				* 0 – 2 V ↑ ↓ 8 – 14 V (Reference waveform No.5)	Ignition switch is turned to ST (cranking) position. (Output signal is active low duty pulse. Pulse generated times depending on vehicle condition)
	29	GRN/ORN	EGR valve (stepper motor coil 2) output	10 – 14 V	Ignition switch turned ON
				* 0 – 2 V ↑ ↓ 8 – 14 V (Reference waveform No.5)	Ignition switch is turned to ST (cranking) position. (Output signal is active low duty pulse. Pulse generated times depending on vehicle condition)
	30	–	–	–	–
	31	BLU/RED	Fuel injector No.3 output	10 – 14 V	Ignition switch turned ON
				* 0 – 0.6 V ↑ ↓ 10 – 14 V (Reference waveform No.10, No.12 and No.26)	Engine running (Output signal is active low pulse. Pulse frequency varies depending on engine speed.)

Terminal number		Wire color	Circuit	Normal Voltage	Condition
C41	1	PNK/BLK	A/C compressor clutch and condenser fan relay output (if equipped)	10 – 14 V	Engine running, A/C request signal high input
				0 – 1 V	Engine running, A/C request signal low input
	2	RED/BLK	Oil control valve ground	Below 0.3 V	Ignition switch turned ON
	3	GRN/BLK	Oil control valve output	* 0 – 0.6 V ↑ ↓ 13 – 14 V (Reference waveform No.8 and No.9)	Ignition switch turned ON
					While engine running (Output signal is active low pulse. Duty ratio varies depending on vehicle condition.)
	4	PNK/BLU	Heater output of heated oxygen sensor–2	10 – 14 V	Ignition switch turned ON
				* 0 – 1 V (Reference waveform No.1)	Engine running at idling after vehicle running over 30 km/h, 19 ml/h for 5 min.
	5	BLK/RED	Main power supply	10 – 14 V	Ignition switch turned ON
	6	BLK/RED	Main power supply	10 – 14 V	Ignition switch turned ON
	7	WHT/RED	Power source for ECM internal memory	10 – 14 V	Ignition switch turned ON and turned OFF

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Terminal number		Wire color	Circuit	Normal Voltage	Condition
C41	8	YEL/RED	Fuel level sensor signal (vehicle with immobilizer indicator lamp)	0 – 6 V	Ignition switch turned ON Voltage depends on fuel level
		PNK/BLU	Duty output signal (vehicle without immobilizer indicator lamp)	10 – 14 V	Ignition switch turned ON
	9	PPL/YEL	Radiator fan relay No.2 and No.3 output	10 – 14 V	Ignition switch ON and engine coolant temperature less than 100°C, 212°F
				0 – 1V	Ignition switch ON and engine coolant temperature more than 102.5°C, 216.5°F
	10	BRN/WHT	Main power supply relay output	10 – 14 V	Ignition switch is turned OFF
				0 – 2 V	Ignition switch is turned ON
	11	BLK/WHT	Ignition switch signal	0 – 1 V	Ignition switch turned OFF
				10 – 14 V	Ignition switch turned ON
	12	–	–	–	–
	13	BRN	Oxygen signal of heated oxygen sensor-2	0.5 – 1.5 V	Ignition switch turned ON
				* Deflects between over 0.5 V and under 0.45 V (Reference waveform No.1)	While engine running at 2,000 r/min. for 1 min. or longer after vehicle running over 30 km/h, 19 ml/h
	14	PPL/WHT	Diagnosis switch signal (vehicle without immobilizer indicator lamp)	4 – 6 V	Ignition switch turned ON
	15	WHT/GRN	Test switch signal (vehicle without immobilizer indicator lamp)	4 – 6 V	Ignition switch turned ON
	16	YEL/GRN	A/C switch signal (if equipped)	10 – 14 V (High input)	Ignition switch turned ON, blower fan selector selected OFF position or A/C switch turned OFF or A/C evaporator temp. less than 2.5°C, 36.5°F
				0 – 1V (Low input)	Ignition switch turned ON, blower fan selector selected ON position and A/C switch turned ON with A/C evaporator temp. more than 4°C, 39.2°F
	17	RED/YEL	Electric load signal for clearance lamp	0 – 1V	Ignition switch turned ON, Clearance lamp not lighted up
				10 – 14 V	Ignition switch turned ON, Clearance lamp lighted up

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Terminal number		Wire color	Circuit	Normal Voltage	Condition
C41	18	BLU	Radiator fan relay No.1 output	10 – 14 V	Ignition switch ON and engine coolant temperature less than 95°C, 203°F
				0 – 1V	Ignition switch ON and engine coolant temperature more than 97.5°C, 208°F
	19	PNK	Fuel pump relay output	0 – 2.5 V	For 3 sec. from the time is ignition switch turned to ON or while engine is running
				10 – 14 V	On and after 3 sec. from the time is ignition switch turned to ON or while engine is stop
	20	BLK/YEL	Starting motor signal	0 – 1 V	Ignition switch turned ON
				6 – 14 V	While engine cranking
	21	GRN/WHT	Electric load signal for stop lamp	0 – 1V	Ignition switch turned ON, Stop lamp not lighted up
				10 – 14 V	Ignition switch turned ON, Stop lamp lighted up
	22	PPL	Vehicle speed sensor signal	* 0 – 1 V ↑ ↓ 10 – 14 V (Reference waveform No.20)	Vehicle running. (Sensor signal is pulse. Pulse frequency varies depending on vehicle speed. (8190 pulses are generated par 60 km/h, 37.5 ml/h)
	23	–	–	–	–
	24	–	–	–	–

Terminal number		Wire color	Circuit	Normal Voltage	Condition
G02	1	WHT/BLK	A/C evaporator outlet air temp. sensor signal (if equipped)	3.3 – 3.8 V	Ignition switch turned ON at A/C evaporator inlet air temperature 0°C (32°F)
				2.5 – 2.9 V	Ignition switch turned ON at A/C evaporator inlet air temperature 15°C (59°F)
				1.9 – 2.3 V	Ignition switch turned ON at A/C evaporator inlet air temperature 25°C (77°F)
	2	–	–	–	–
	3	–	–	–	–
	4	–	–	–	–
	5	–	–	–	–
	6	–	–	–	–
	7	YEL	Serial communication line of data link connector 5 V	4 – 6 V	Ignition switch turned ON
	8	PNK	Immobilizer indicator lamp output (if equipped)	10 – 14 V	While engine running
				0 – 1V	Ignition switch turned ON with engine stop

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Terminal number		Wire color	Circuit	Normal Voltage	Condition
G02	9	PPL/WHT	MIL (Malfunction indicator lamp) output	0 – 2.5 V	Ignition switch turned ON with engine stop
				10 – 14 V	Engine running
	10	–	–	–	–
	11	BLU	Serial communication line of data link connector 12 V	10 – 14 V	Ignition switch turned ON
	12	–	–	–	–
	13	PNK/BLU	Electric load signal for heater blower motor	10 – 14 V	Ignition switch turned ON, blower fan selector selected at 1st speed position or OFF
				0 – 1V	Ignition switch turned ON, blower fan selector selected at 2nd speed position or more
	14	ORN	Ground for A/C evaporator outlet air temp. sensor (if equipped)	Below 0.3 V	Ignition switch turned ON
	15	–	–	–	–
	16	BRN	Engine revolution signal output for tachometer	0 – 0.8 V	Ignition switch turned ON with engine stop
				* 0 – 1 V ↑ ↓ 8 – 14 V (Reference waveform No.21 and No.22)	While engine running. (Output signal is pulse. Pulse frequency varies depending on engine speed.) (2 pulses are generated par 1crankshaft revolution). (3000 r/min = 100 Hz)
	17	WHT/GRN	ECT sensor signal for combination meter	* 0 – 0.6 V ↑ ↓ 13 – 14 V (Reference waveform No.23)	Ignition switch turned ON (Output signal is 5 Hz active low duty pulse. Duty ratio varies depending on ECT.) ECT –30°C = 10% ON duty ECT 130°C = 90% ON duty

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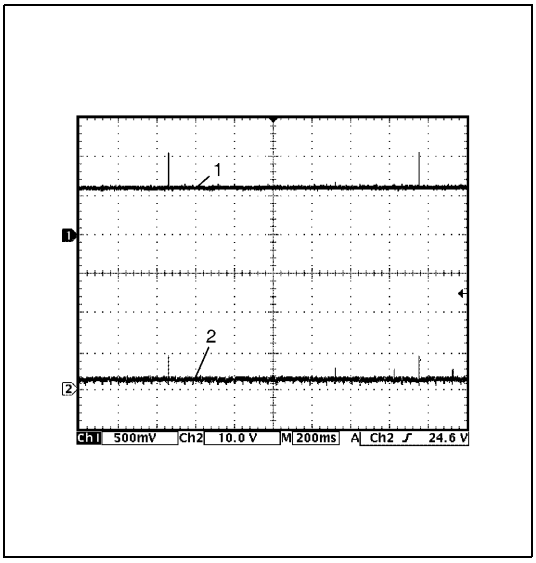
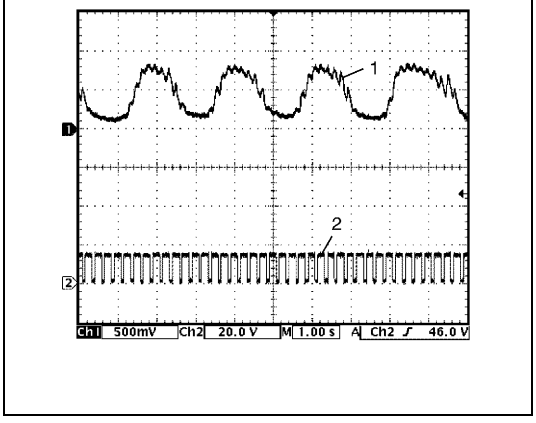


1. Reference waveform No.1

Heated oxygen sensor–2 heater signal at engine idling

Measurement terminal	CH1: C41-13 to C42-1 CH2: C41-4 to C42-1
Oscilloscope setting	CH1: 500 mV/DIV, CH2: 10 V/DIV TIME: 200 ms/DIV
Measurement condition	• After warmed up to normal operating temperature • Drive vehicle at 60 km/h (37 mil/h) for 10 min. • Engine at specified idle speed

1. Heated oxygen sensor–2 signal
2. Heated oxygen sensor–2 heater signal

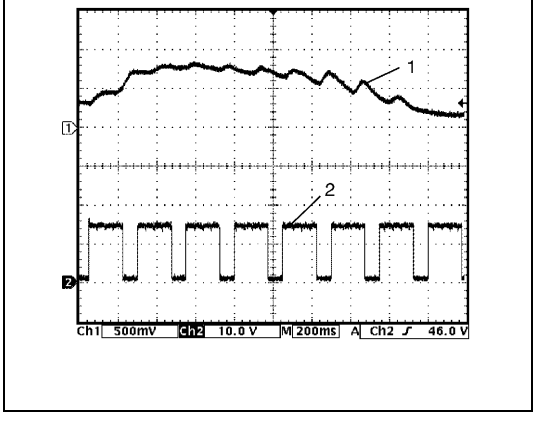


2. Reference waveform No.2

Heated oxygen sensor–1 signal at engine idling

Measurement terminal	CH1: C42-13 to C42-1 CH2: C42-7 to C42-1
Oscilloscope setting	CH1: 500 mV/DIV, CH2: 20 V/DIV TIME: 1 s/DIV
Measurement condition	• After warmed up to normal operating temperature • Engine at specified idle speed

1. Heated oxygen sensor–1 signal
2. Heated oxygen sensor–1 heater signal



3. Reference waveform No.3

Heated oxygen sensor–1 heater signal at engine idling

Measurement terminal	CH1: C42-13 to C42-1 CH2: C42-7 to C42-1
Oscilloscope setting	CH1: 500 mV/DIV, CH2: 10 V/DIV TIME: 200 ms/DIV
Measurement condition	• After warmed up to normal operating temperature • Engine at specified idle speed

1. Heated oxygen sensor–1 signal
2. Heated oxygen sensor–1 heater signal

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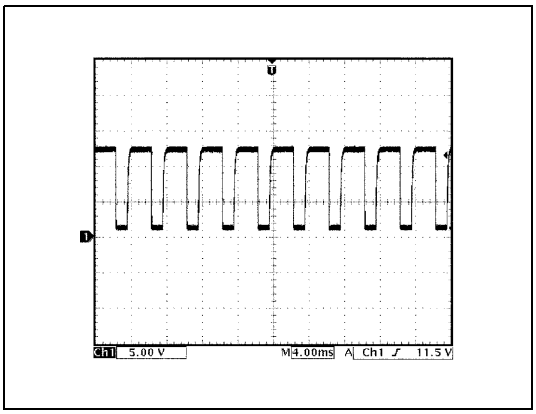
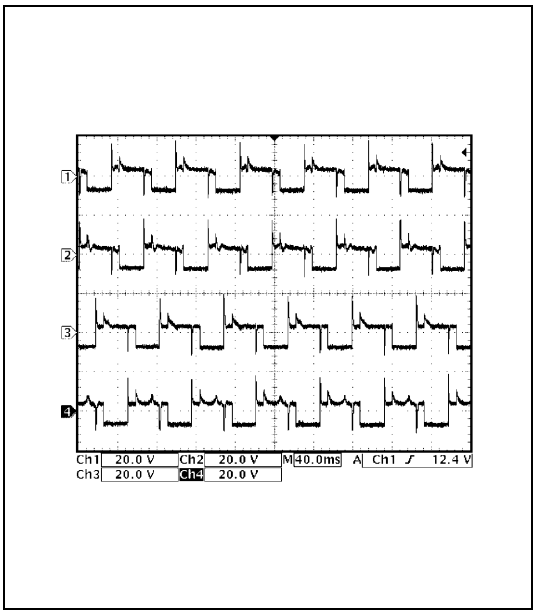


4. Reference waveform No.4

IAC valve signal

Measurement terminal	CH1: C42-6 to C42-1
Oscilloscope setting	CH1: 5 V/DIV TIME: 4 ms/DIV
Measurement condition	• After warmed up to normal operating temperature • Engine at specified idle speed

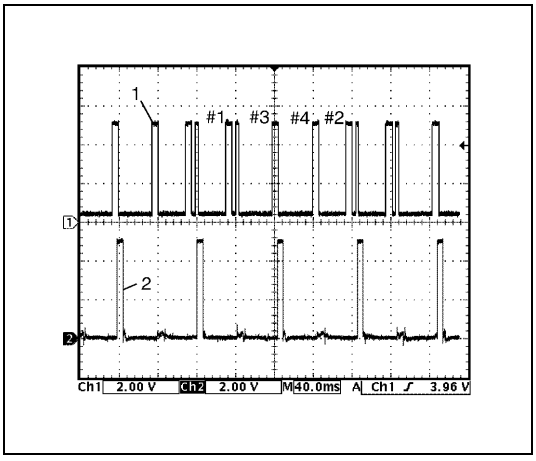


5. Reference waveform No.5

EGR valve signal

Measurement terminal	CH1: C42-18 to C42-1 CH2: C42-29 to C42-1 CH3: C42-17 to C42-1 CH4: C42-28 to C42-1
Oscilloscope setting	CH1: 20 V/DIV, CH2: 20 V/DIV CH3: 20 V/DIV, CH4: 20 V/DIV TIME: 40 ms/DIV
Measurement condition	Engine at cranking

1. EGR valve stepper motor coil 1 signal
2. EGR valve stepper motor coil 2 signal
3. EGR valve stepper motor coil 3 signal
4. EGR valve stepper motor coil 4 signal



6. Reference waveform No.6

Ignition coil No.2 and No.3 signal at engine idling

Measurement terminal	CH1: C42-11 to C42-1 CH2: C42-19 to C42-1
Oscilloscope setting	CH1: 2 V/DIV, CH2: 2 V/DIV TIME: 40 ms/DIV
Measurement condition	• After warmed up to normal operating temperature • Engine at specified idle speed

1. Cylinder reference signal (CMP reference signal)
2. No.2 and No.3 ignition signal

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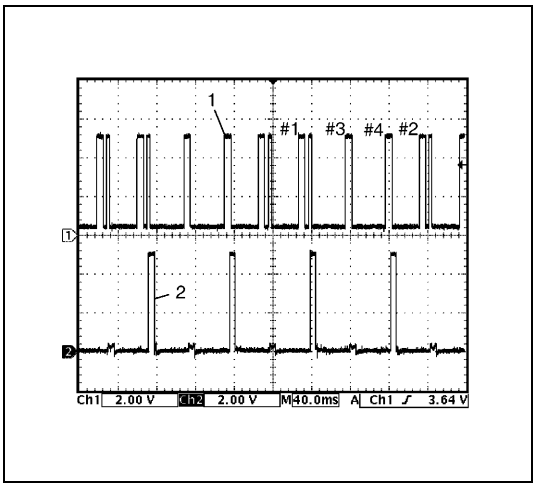
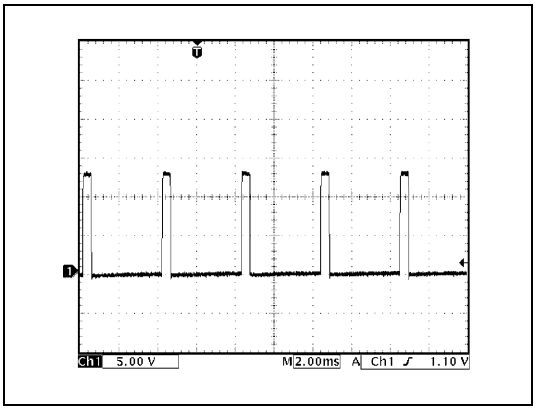


7. Reference waveform No.7

Ignition coil No.1 and No.4 signal at engine idling

Measurement terminal	CH1: C42-11 to C42-1 CH2: C42-20 to C42-1
Oscilloscope setting	CH1: 2 V/DIV, CH2: 2 V/DIV TIME: 40 ms/DIV
Measurement condition	• After warmed up to normal operating temperature • Engine at specified idle speed

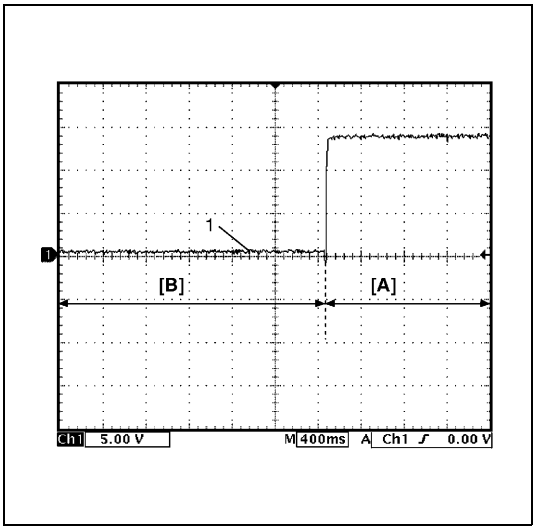
1. Cylinder reference signal (CMP reference signal)
2. No.1 and No.4 ignition signal



8. Reference waveform No.8

Oil control valve signal

Measurement terminal	CH1: C41-3 to C41-2
Oscilloscope setting	CH1: 5 V/DIV TIME: 2 ms/DIV
Measurement condition	At the moment of the ignition switch in turned on



9. Reference waveform No.9

Oil control valve signal at vehicle driving

Measurement terminal	CH1: C41-3 to C41-2
Oscilloscope setting	CH1: 5 V/DIV TIME: 400 ms/DIV
Measurement condition	• After warmed up to normal operating temperature • Drive vehicle at 20 km/h (12 mil/h) and depress accelerator pedal fully

[A]: Accelerator pedal depress fully
[B]: Accelerator pedal depress partially
1. Oil control valve signal

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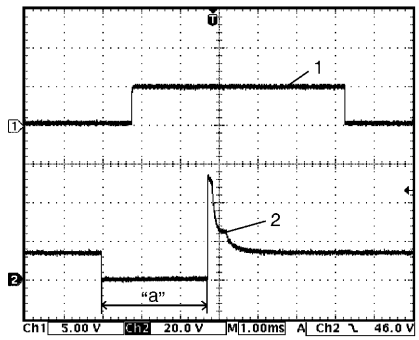
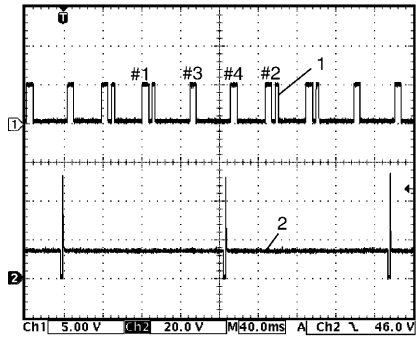


10. Reference waveform No.10

Fuel injector signal at engine idling

Measurement terminal	CH1: C42-11 to C42-1 CH2: C42-21 to C42-1
Oscilloscope setting	CH1: 5 V/DIV, CH2: 20 V/DIV TIME: 1 ms/DIV
Measurement condition	• After warmed up to normal operating temperature • Engine at specified idle speed

1. Cylinder reference signal (CMP reference signal)
2. Fuel injector signal
a. Fuel injection pulse width: 2 – 4 msec

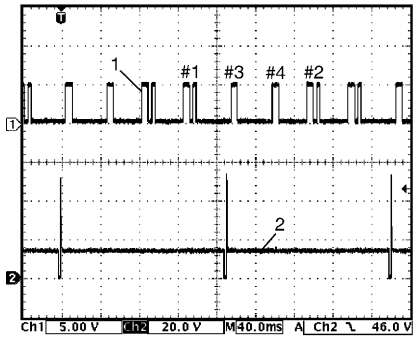


11. Reference waveform No.11

No.4 fuel injector signal at engine idling

Measurement terminal	CH1: C42-11 to C42-1 CH2: C42-8 to C42-1
Oscilloscope setting	CH1: 5 V/DIV, CH2: 20 V/DIV TIME: 40 ms/DIV
Measurement condition	• After warmed up to normal operating temperature • Engine at specified idle speed

1. Cylinder reference signal (CMP reference signal)
2. No.4 fuel injector signal



12. Reference waveform No.12

No.3 fuel injector signal at engine idling

Measurement terminal	CH1: C42-11 to C42-1 CH2: C42-31 to C42-1
Oscilloscope setting	CH1: 5 V/DIV, CH2: 20 V/DIV TIME: 40 ms/DIV
Measurement condition	• After warmed up to normal operating temperature • Engine at specified idle speed

1. Cylinder reference signal (CMP reference signal)
2. No.3 fuel injector signal

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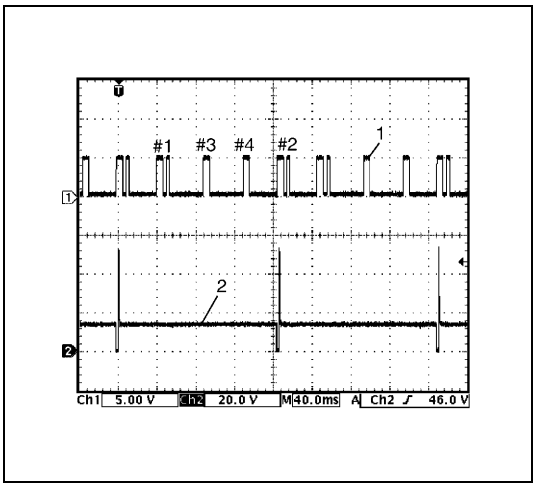
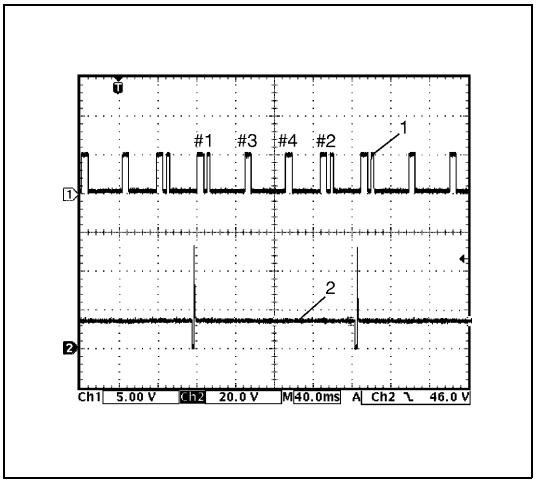


13. Reference waveform No.13

No.2 fuel injector signal at engine idling

Measurement terminal	CH1: C42-11 to C42-1 CH2: C42-21 to C42-1
Oscilloscope setting	CH1: 5 V/DIV, CH2: 20 V/DIV TIME: 40 ms/DIV
Measurement condition	• After warmed up to normal operating temperature • Engine at specified idle speed

1. Cylinder reference signal (CMP reference signal)
2. No.2 fuel injector signal

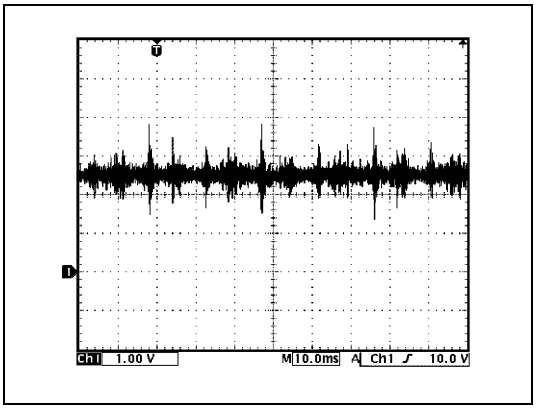


14. Reference waveform No.14

No.1 fuel injector signal at engine idling

Measurement terminal	CH1: C42-11 to C42-1 CH2: C42-9 to C42-1
Oscilloscope setting	CH1: 5 V/DIV, CH2: 20 V/DIV TIME: 40 ms/DIV
Measurement condition	• After warmed up to normal operating temperature • Engine at specified idle speed

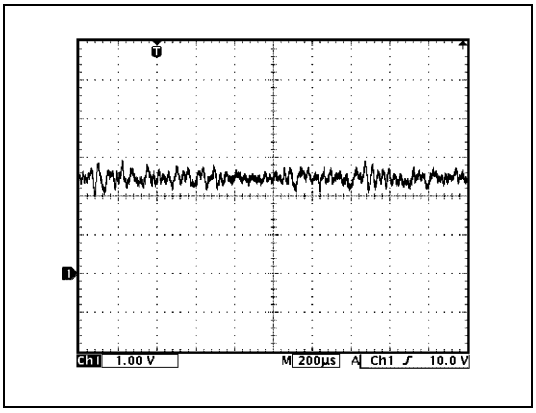
1. Cylinder reference signal (CMP reference signal)
2. No.1 fuel injector signal



15. Reference waveform No.15

Knock sensor signal at engine speed 4000 r/min.

Measurement terminal	CH1: C42-25 to C42-1
Oscilloscope setting	CH1: 1 V/DIV TIME: 10 ms/DIV
Measurement condition	• After warmed up to normal operating temperature • Run engine at 4000 r/min.



16. Reference waveform No.16

Knock sensor signal at engine speed 4000 r/min.

Measurement terminal	CH1: C42-25 to C42-1
Oscilloscope setting	CH1: 1 V/DIV TIME: 200 µs/DIV
Measurement condition	• After warmed up to normal operating temperature • Run engine at 4000 r/min.

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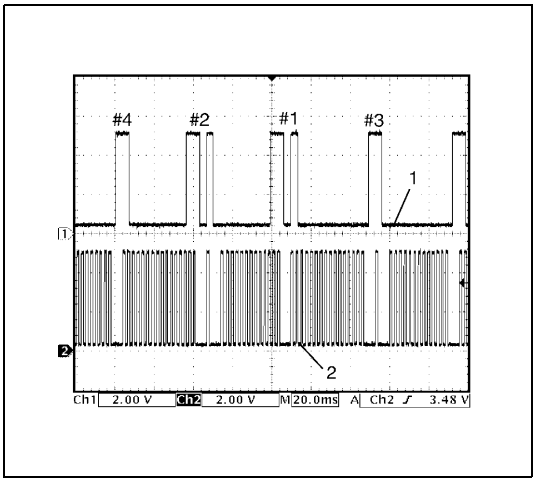
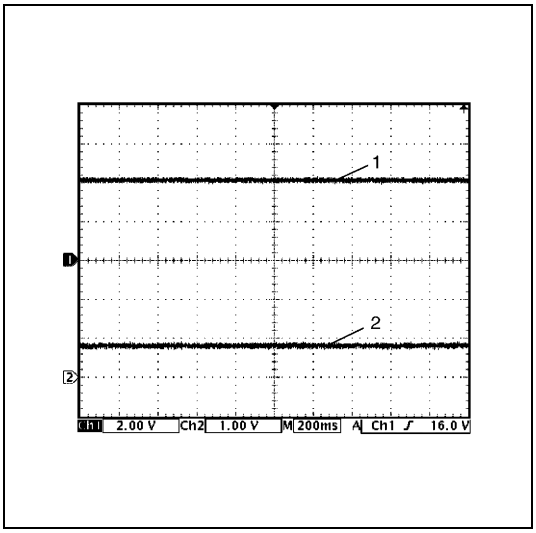


17. Reference waveform No.17

CMP sensor signal at engine idling

Measurement terminal	CH1: C42-11 to C42-1 CH2: C42-23 to C42-1
Oscilloscope setting	CH1: 2 V/DIV, CH2: 2 V/DIV TIME: 20 ms/DIV
Measurement condition	• After warmed up to normal operating temperature • Engine at specified idle speed

1. Cylinder reference signal (CMP reference signal)
2. CKP signal

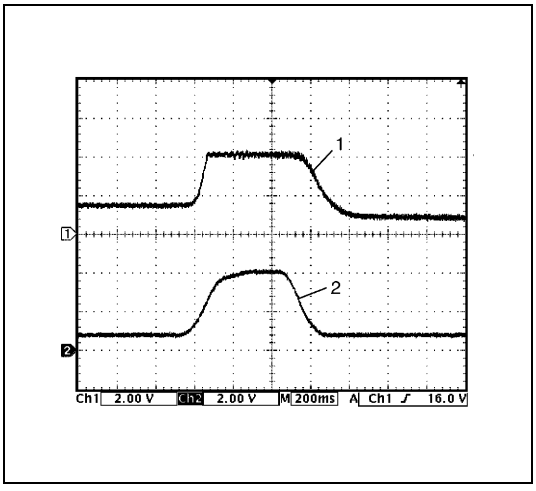


18. Reference waveform No.18

Manifold absolute pressure sensor signal at ignition switch turned ON

Measurement terminal	CH1: C42-26 to C42-10 CH2: C42-16 to C42-10
Oscilloscope setting	CH1: 2 V/DIV, CH2: 2 V/DIV TIME: 200 ms/DIV
Measurement condition	• After warmed up to normal operating temperature • Ignition switch turned ON

1. Manifold absolute pressure sensor signal
2. Throttle position sensor signal



19. Reference waveform No.19

Manifold absolute pressure sensor signal at engine racing

Measurement terminal	CH1: C42-26 to C42-10 CH2: C42-16 to C42-10
Oscilloscope setting	CH1: 2 V/DIV, CH2: 2 V/DIV TIME: 200 ms/DIV
Measurement condition	• After warmed up to normal operating temperature • Engine racing

1. Manifold absolute pressure sensor signal
2. Throttle position sensor signal

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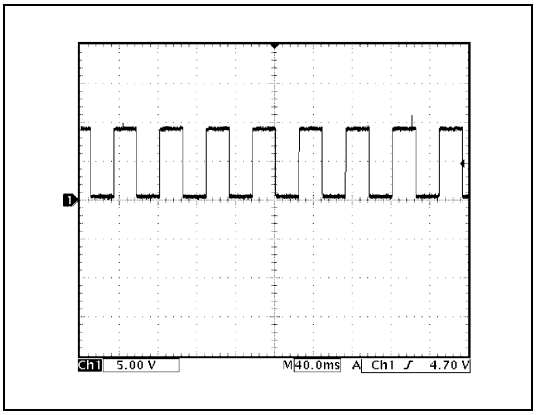
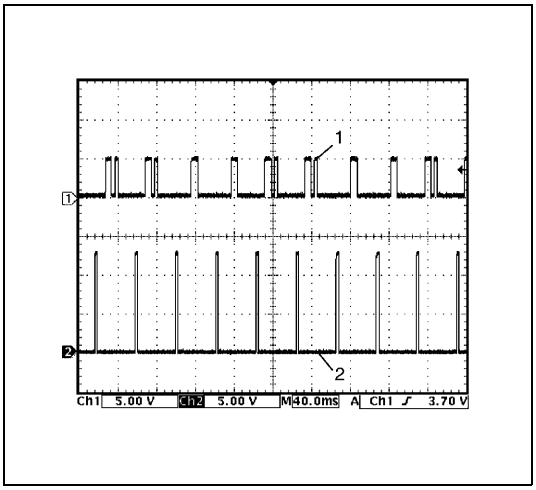


20. Reference waveform No.20

VSS signal at 30 km/h (19 mil/h)

Measurement terminal	CH1: C41-22 to C42-1
Oscilloscope setting	CH1: 5 V/DIV TIME: 40 ms/DIV
Measurement condition	• After warmed up to normal operating temperature • Drive vehicle at 30 km/h (19 mil/h)

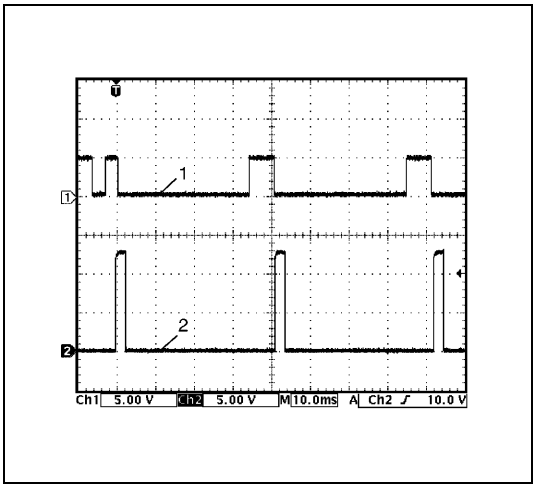


21. Reference waveform No.21

Ignition pulse (engine revolution) signal at engine idling

Measurement terminal	CH1: C42-11 to C42-1 CH2: G02-16 to C42-1
Oscilloscope setting	CH1: 5 V/DIV, CH2: 5 V/DIV TIME: 40 ms/DIV
Measurement condition	• After warmed up to normal operating temperature • Engine at specified idle speed

1. Cylinder reference signal (CMP reference signal)
2. Ignition pulse signal

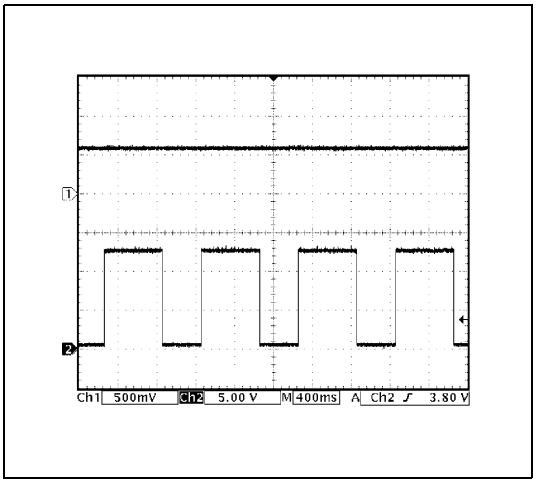


22. Reference waveform No.22

Ignition pulse (engine revolution) signal at engine idling

Measurement terminal	CH1: C42-11 to C42-1 CH2: G02-16 to C42-1
Oscilloscope setting	CH1: 5 V/DIV, CH2: 5 V/DIV TIME: 10 ms/DIV
Measurement condition	• After warmed up to normal operating temperature • Engine at specified idle speed

1. Cylinder reference signal (CMP reference signal)
2. Ignition pulse signal



23. Reference waveform No.23

Engine coolant temperature signal at engine idling

Measurement terminal	CH1: C42-14 to C42-10 CH2: G02-17 to C42-1
Oscilloscope setting	CH1: 500 mV/DIV, CH2: 5 V/DIV TIME: 400 ms/DIV
Measurement condition	• After warmed up to normal operating temperature • Engine at specified idle speed

1. Engine coolant temperature signal for combination meter
2. Engine coolant temperature sensor signal

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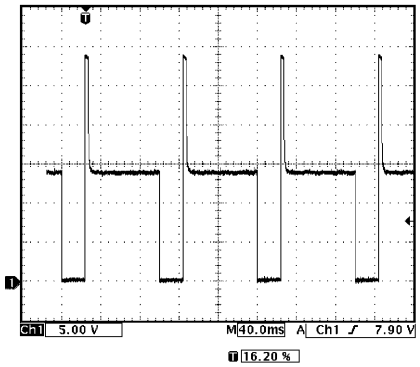
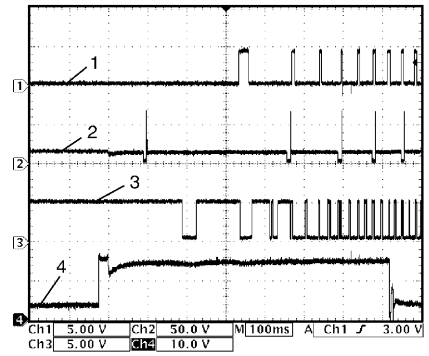


24. Reference waveform No.24

EVAP canister purge valve signal

Measurement terminal	CH1: C42-4 to C42-1
Oscilloscope setting	CH1: 5 V/DIV TIME: 40 ms/DIV
Measurement condition	• After warmed up to normal operating temperature • Drive vehicle at 40 km/h (25 mil/h) or more

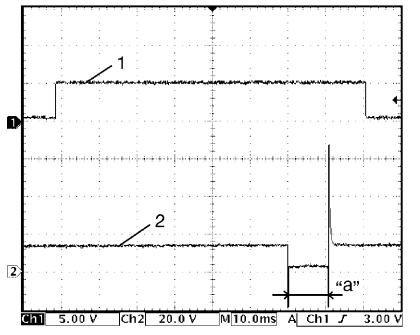


25. Reference waveform No.25

Ignition coil signal and fuel injector signal at engine cranking

Measurement terminal	CH1: C42-20 to C42-1 CH2: C42-9 to C42-1 CH3: C42-11 to C42-1 CH4: C41-20 to C42-1
Oscilloscope setting	CH1: 5 V/DIV, CH2: 50 V/DIV CH3: 5 V/DIV, CH4: 10 V/DIV TIME: 100 ms/DIV
Measurement condition	• After warmed up to normal operating temperature • Engine at cranking

1.	Ignition coil No.1 and No.4 signal
2.	No.1 fuel injector signal
3.	Cylinder reference signal (CMP reference signal)
4.	Starting motor signal



26. Reference waveform No.26

Fuel injector signal at engine cranking

Measurement terminal	CH1: C42-11 to C42-1 CH2: C42-21 to C42-1
Oscilloscope setting	CH1: 5 V/DIV, CH2: 20 V/DIV TIME: 10 ms/DIV
Measurement condition	• After warmed up to normal operating temperature • Engine at cranking

1.	Cylinder reference signal (CMP reference signal)
2.	Fuel injector signal
a.	Injection pulse width: 10 – 14 msec

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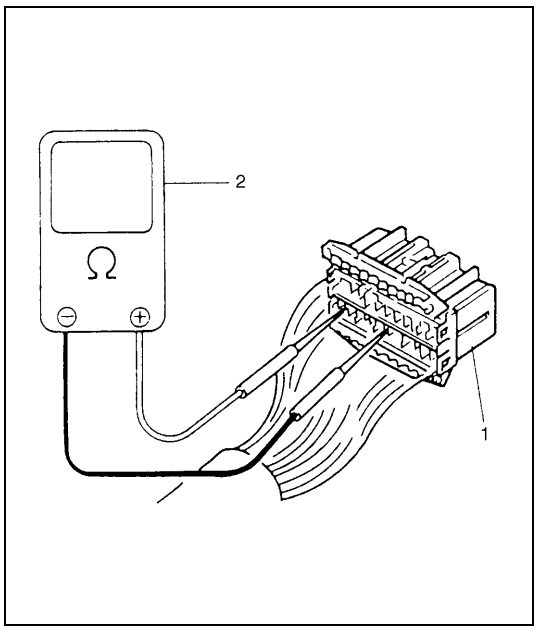
Resistance check



1) Disconnect ECM couplers (1) from ECM with ignition switch OFF.

CAUTION:
Never touch terminals of ECM itself or connect voltmeter or ohmmeter (2).

2) Check resistance between each terminal of connectors disconnected.

CAUTION:
- **Be sure to connect ohmmeter probe from wire harness side of coupler.**
- **Be sure to turn OFF ignition switch for this check.**
- **Resistance in table below represents that when parts temperature is 20°C (68°F).**

TERMINAL RESISTANCE TABLE

TERMINALS	CIRCUIT	STANDARD RESISTANCE
C42-7 to C41-11	Heater of HO2S–1	5.0 – 6.4 Ω
C41-4 to C41-11	Heater of HO2S–2	11.5 – 16.5 Ω
C42-9 to C41-5/6	No.1 injector	11.3 – 13.8 Ω
C42-21 to C41-5/6	No.2 injector	11.3 – 13.8 Ω
C42-31 to C41-5/6	No.3 injector	11.3 – 13.8 Ω
C42-8 to C41-5/6	No.4 injector	11.3 – 13.8 Ω
C42-18 to C41-5/6	EGR valve (stepper motor coil 1)	20 – 24 Ω
C42-29 to C41-5/6	EGR valve (stepper motor coil 2)	20 – 24 Ω
C42-17 to C41-5/6	EGR valve (stepper motor coil 3)	20 – 24 Ω
C42-28 to C41-5/6	EGR valve (stepper motor coil 4)	20 – 24 Ω
C42-4 to C41-5/6	EVAP canister purge valve	30 – 34 Ω
C41-2 to C41-3	Oil control valve	6.5 – 10 Ω
C41-19 to C41-11	Fuel pump relay	160 – 240 Ω
C41-18 to C41-5/6	Radiator fan control relay No.1	160 – 240 Ω
C41-10 to C41-7	Main relay	160 – 240 Ω
C42-1 to Body ground	Ground	Less than 1 Ω
C42-2 to Body ground	Ground	Less than 1 Ω
C42-3 to Body ground	Ground	Less than 1 Ω

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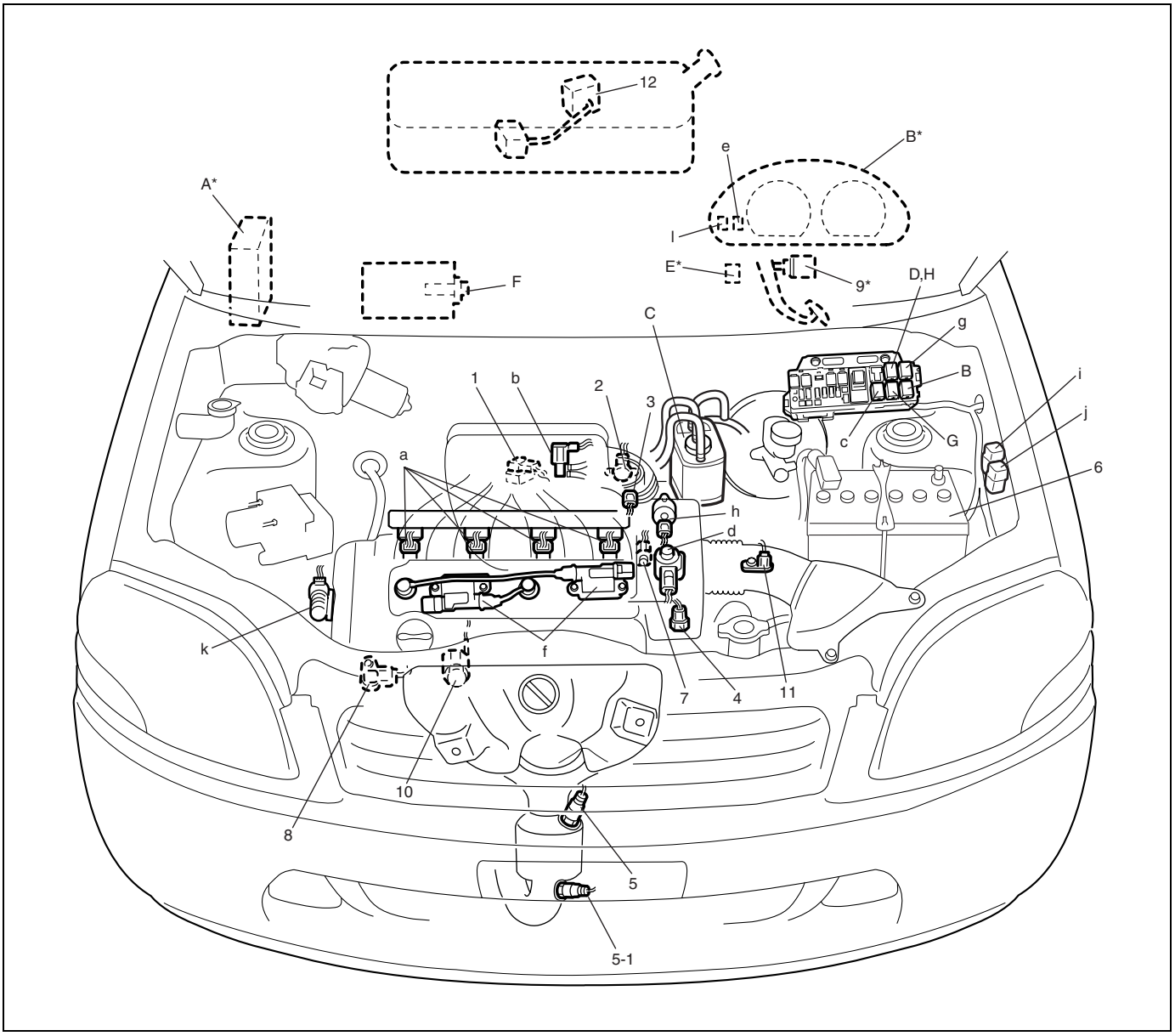
Component Location



INFORMATION SENSORS	CONTROL DEVICES	OTHERS
1. MAP sensor	a: Fuel injector	A: ECM
2. TP sensor	b: EVAP canister purge valve	B: Main relay
3. IAT sensor	c: Fuel pump relay	C: EVAP canister
4. ECT sensor	d: EGR valve (stepper motor)	D: Monitor connector (if equipped)
5. Heated oxygen sensor–1	e: Malfunction indicator lamp	E: Data link connector
5-1. Heated oxygen sensor–2 (if equipped)	f: Ignition coil assembly	F: A/C EVAP outlet air temp. sensor (if equipped)
6. Battery	g: Radiator fan control relay No.1	G: A/C condenser fan relay (if equipped)
7. CMP sensor	h: IAC valve	H: A/C compressor relay (if equipped)
8. CKP sensor	i: Radiator fan control relay No.2	
9. Stop lamp switch	j: Radiator fan control relay No.3	
10. Knock sensor	k. Oil control valve	
11. VSS	l. Immobilizer indicator lamp (if equipped)	
12. Fuel level sensor		

NOTE:

Above figure shows left-hand steering vehicle. For right-hand steering vehicle, parts with (*) are installed at the opposite side.

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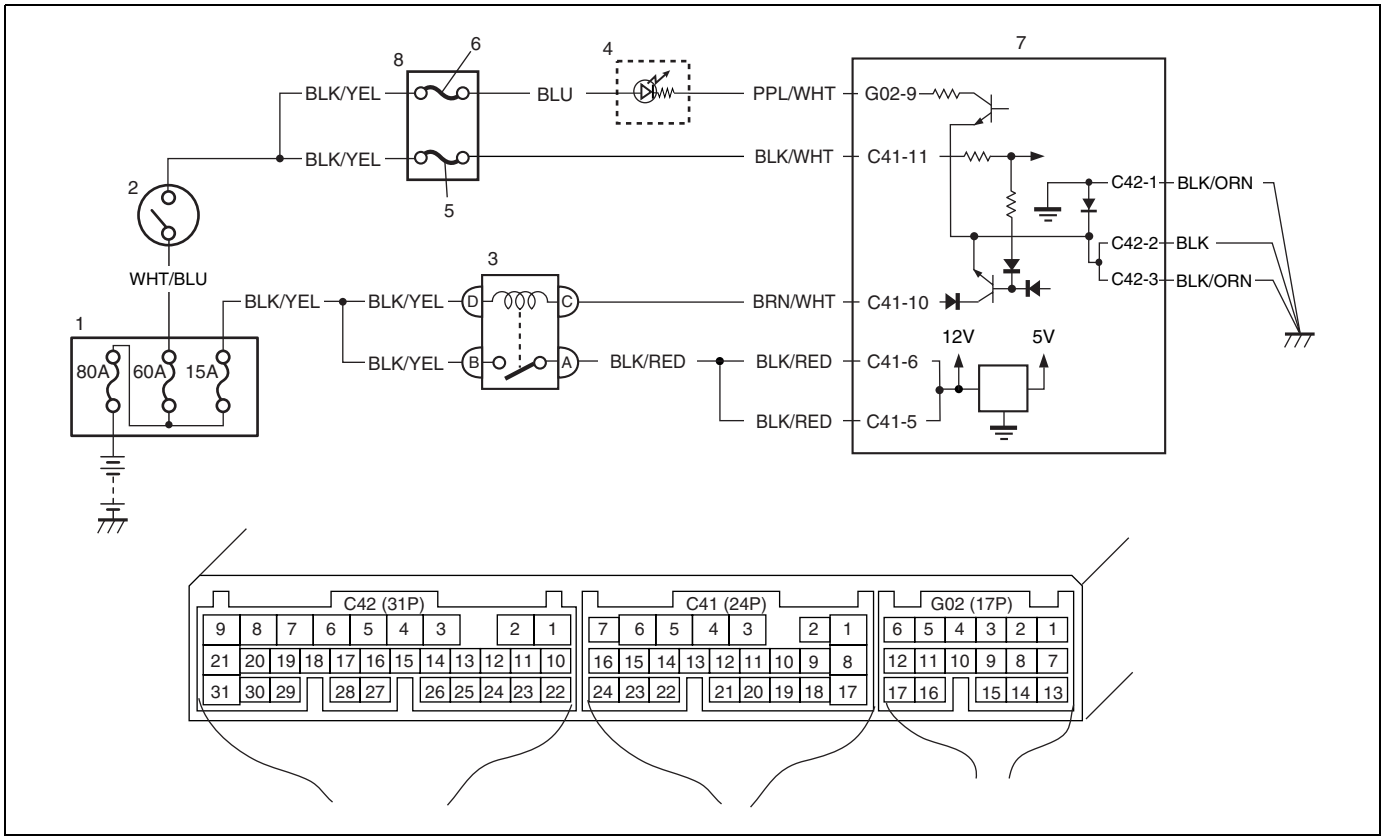
Table A-1 Malfunction Indicator Lamp Circuit Check – Lamp Does Not Come "ON" with Ignition Switch ON (But Engine Stops)

Wiring Diagram



1. Relay box	4. Malfunction indicator lamp in combination meter	7. ECM
2. Ignition switch	5. "IG" fuse	8. Circuit fuse box
3. Main relay	6. "METER" fuse	

Circuit Description

When the ignition switch is turned ON, ECM causes the main relay to turn ON (close the contact point). Then, ECM being supplied with the main power, turns ON the malfunction indicator lamp (MIL). When the engine starts to run and no malfunction is detected in the system, MIL goes OFF but if a malfunction was or is detected, MIL remains ON even when the engine is running.

Troubleshooting

Step	Action	Yes	No
1	MIL Power Supply Check 1) Turn ignition switch to ON position. Do other warning lights come ON?	Go to Step 4.	Go to Step 2.
2	METER Fuse Check 1) Turn ignition switch to OFF position. 2) Check for fuse blow at "METER" fuse. Is "METER" fuse in good condition?	Go to Step 3.	Replace "METER" fuse and check for short.

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Step	Action	Yes	No
3	MIL Power Supply Check 1) Disconnect ignition switch connector. 2) Remove "METER" fuse. 3) Measure resistance between "BLK/YEL" wire terminal of ignition switch connector and "BLK/YEL" wire terminal of "METER" fuse connector. Is resistance 1Ω or less?	Go to Step 4.	"BLK/YEL" wire circuit open or poor connection.
4	MIL Power Supply Check 1) Connect ignition switch connector. 2) Install "METER" fuse. 3) Remove combination meter referring to "Combination Meter" in Section 8. 4) Check for proper connection to combination meter connector at "BLU" wire and "PPL/WHT" wire terminals. 5) If OK, then turn ignition switch to ON position and measure voltage between combination meter connector at "BLU" wire terminal and body ground. Is it 10 – 14 V?	Go to Step 5.	"BLU" wire circuit open.
5	MIL Circuit Check 1) Turn ignition switch OFF position. 2) Disconnect ECM connector "G02". 3) Check for proper connection to ECM connector at "G02-9" wire terminal. 4) Measure resistance between "PPL/WHT" wire terminal of combination meter connector and "G02-9" wire terminal of ECM connector. Is resistance 1 Ω or less?	Go to Step 6.	"PPL/WHT" wire circuit open.
6	MIL Circuit Check 1) Connect combination meter connectors. 2) Turn ignition switch to ON position. 3) Using service wire, ground "G02-9" terminal wire of disconnected ECM connector. Does MIL turn ON?	Substitute a known-good ECM and recheck.	Replace combination meter.

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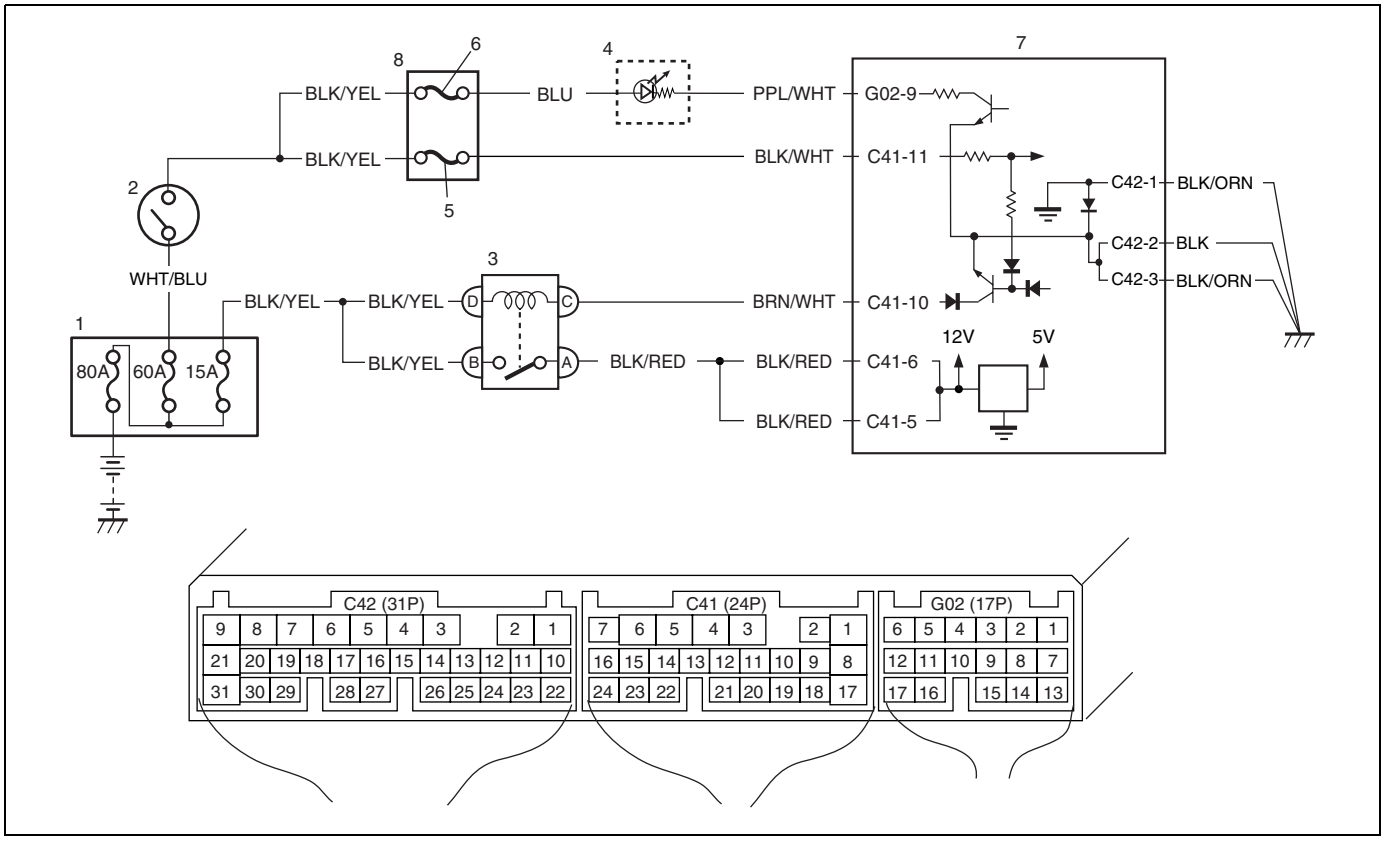
Table A-2 Malfunction Indicator Lamp Circuit Check-lamp Remains "ON" after Engine Starts

Wiring Diagram



1. Relay box	4. Malfunction indicator lamp in combination meter	7. ECM
2. Ignition switch	5. "IG" fuse	8. Circuit fuse box
3. Main relay	6. "METER" fuse	

Circuit Description

When the ignition switch is turned ON, ECM causes the main relay to turn ON (close the contact point). Then, ECM being supplied with the main power, turns ON the malfunction indicator lamp (MIL). When the engine starts to run and no malfunction is detected in the system, MIL goes OFF but if a malfunction was or is detected, MIL remains ON even when the engine is running.

Troubleshooting

Step	Action	Yes	No
1	DTC Check 1) Start engine and recheck DTC while engine running. Is there any DTC(s)?	Go to Step 2 of "Engine and Emission Control System Check" in this section.	Go to Step 2.

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Step	Action	Yes	No
2	MIL Circuit Check 1) Turn ignition switch to OFF position. 2) Remove combination meter referring to “Combination Meter” in Section8. 3) Disconnect connectors from ECM. 4) Measure resistance between “PPL/WHT” wire terminal of combination meter connector and body ground. Is resistance infinity?	Go to Step 3.	“PPL/WHT” wire circuit shorted to ground.
3	MIL Circuit Check 1) Connect connectors to combination meter. Does MIL turn ON at ignition switch turned ON?	Replace combination meter.	Substitute a known-good ECM and recheck.

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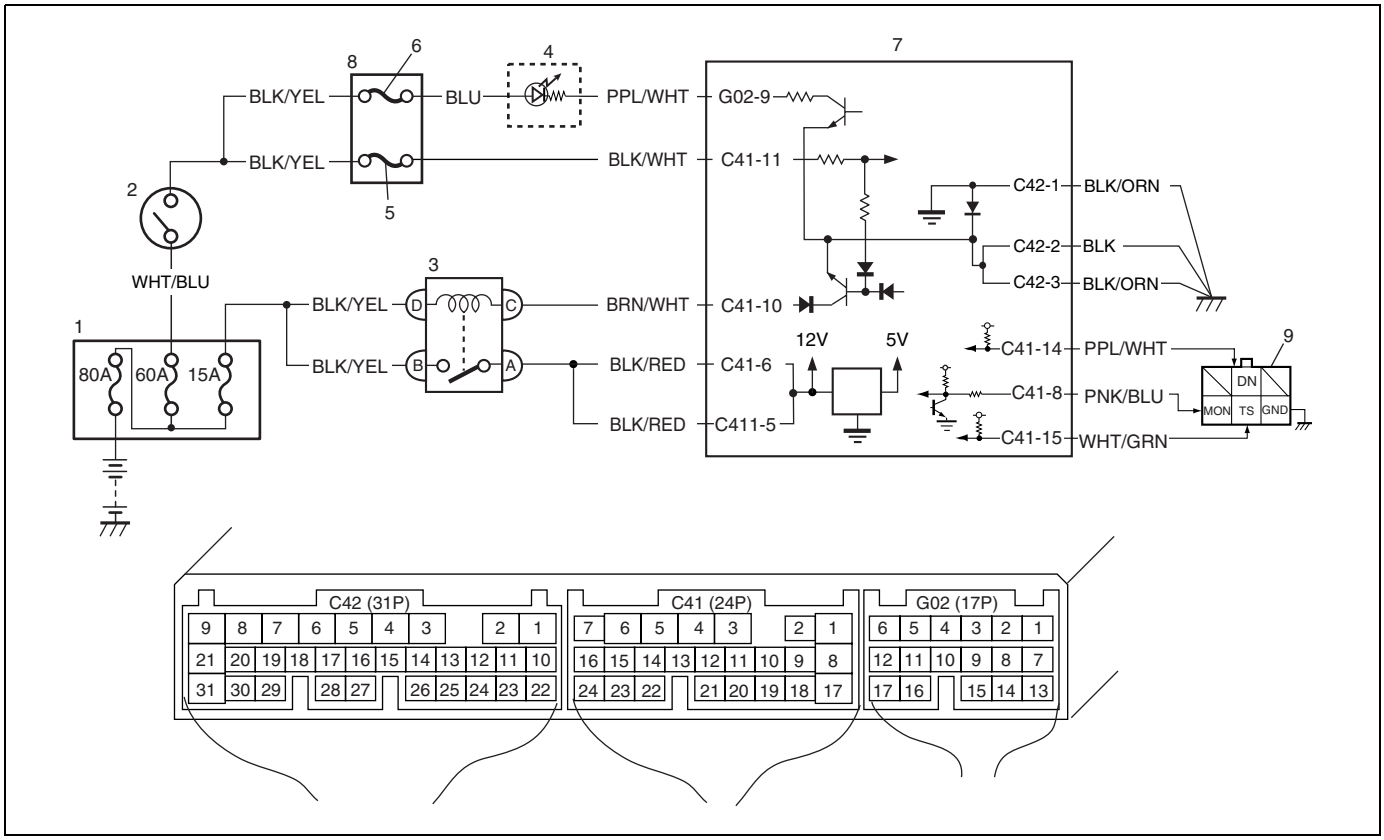
Table A-3 MIL Check – MIL Flashes at Ignition Switch ON (Vehicle without Immobilizer Indicator Lamp)

Wiring Diagram



1. Relay box	4. Malfunction indicator lamp in combination meter	7. ECM
2. Ignition switch	5. "IG COIL" fuse	8. Circuit fuse box
3. Main relay	6. "METER" fuse	9. Diagnosis connector

Circuit Description

When the ignition switch is turned on while the diagnosis switch terminal is connected to the ground terminal in the diagnosis connector, ECM indicates the trouble code by flashing the MIL.

Troubleshooting

Step	Action	Yes	No
1	MIL Flashing Pattern Check 1) Turn ignition switch ON. Does lamp flashing pattern indicate diagnostic trouble code?	Go to Step 2.	Substitute a known-good ECM and recheck.
2	Diag. Switch Circuit Check Is diag. switch terminal connected to ground via service wire?	System is in good condition.	"PPL/WHT" circuit for diagnosis connector shorted to ground. If circuit is OK substitute a known-good ECM and recheck.

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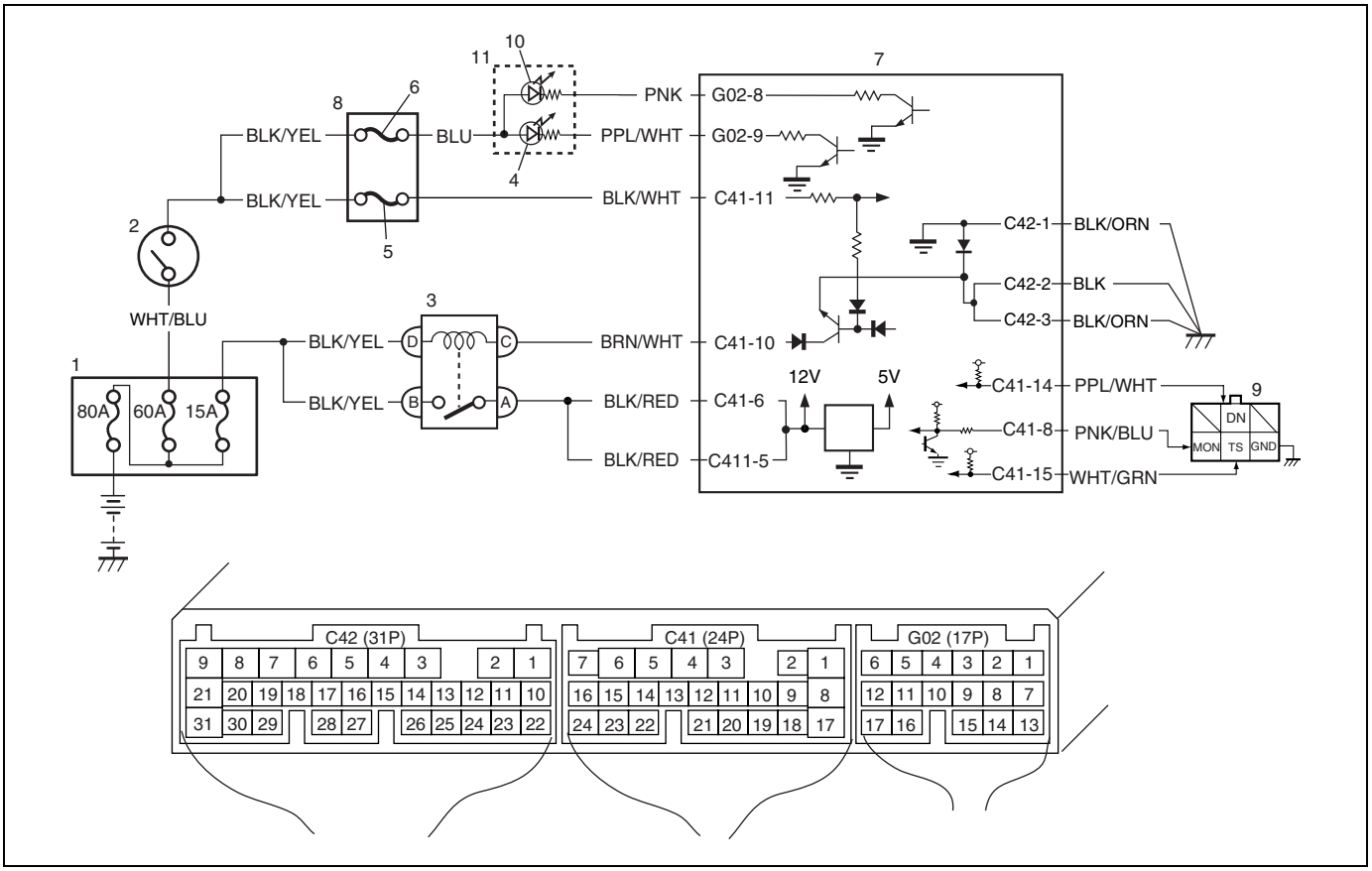
Table A-4 MIL Check – MIL Does Not Flash or Just Remains On Even with Grounding Diagnosis Switch Terminal (Vehicle without Immobilizer Indicator Lamp)

Wiring Diagram



1. Relay box	4. Malfunction indicator lamp in combination meter	7. ECM	10. Immobilizer indicator
2. Ignition switch	5. "IG" fuse	8. Circuit fuse box	11. Combination meter
3. Main relay	6. "METER" fuse	9. Diagnosis connector	

Circuit Description

When the ignition switch is turned on while the diagnosis switch terminal is connected to the ground terminal in the diagnosis connector, ECM indicates the trouble code by flashing the MIL.

Troubleshooting

Step	Action	Yes	No
1	MIL Circuit Check 1) Turn ignition switch OFF and disconnect connectors from ECM. Does MIL turn ON at ignition switch ON?	"PPL/WHT" circuit of G02-9 terminal is shorted to ground.	Go to Step 2.
2	ECM/PCM Connection Check 1) Turn ignition switch OFF. Is connector ("PPL/WHT" wire of C41-14 terminal connection) connected to ECM/PCM properly?	Go to Step 3.	Poor connector connection.

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Step	Action	Yes	No
3	Diag. Switch Terminal Circuit Check 1) Connect connectors to ECM. 2) Using service wire, ground “PPL/WHT” wire of C41-14 terminal with connectors connected to ECM. 3) Turn ignition switch ON. Does MIL flash?	“PPL/WHT” or “BLK” circuit in diagnosis connector is open.	Substitute a known-good ECM and recheck.

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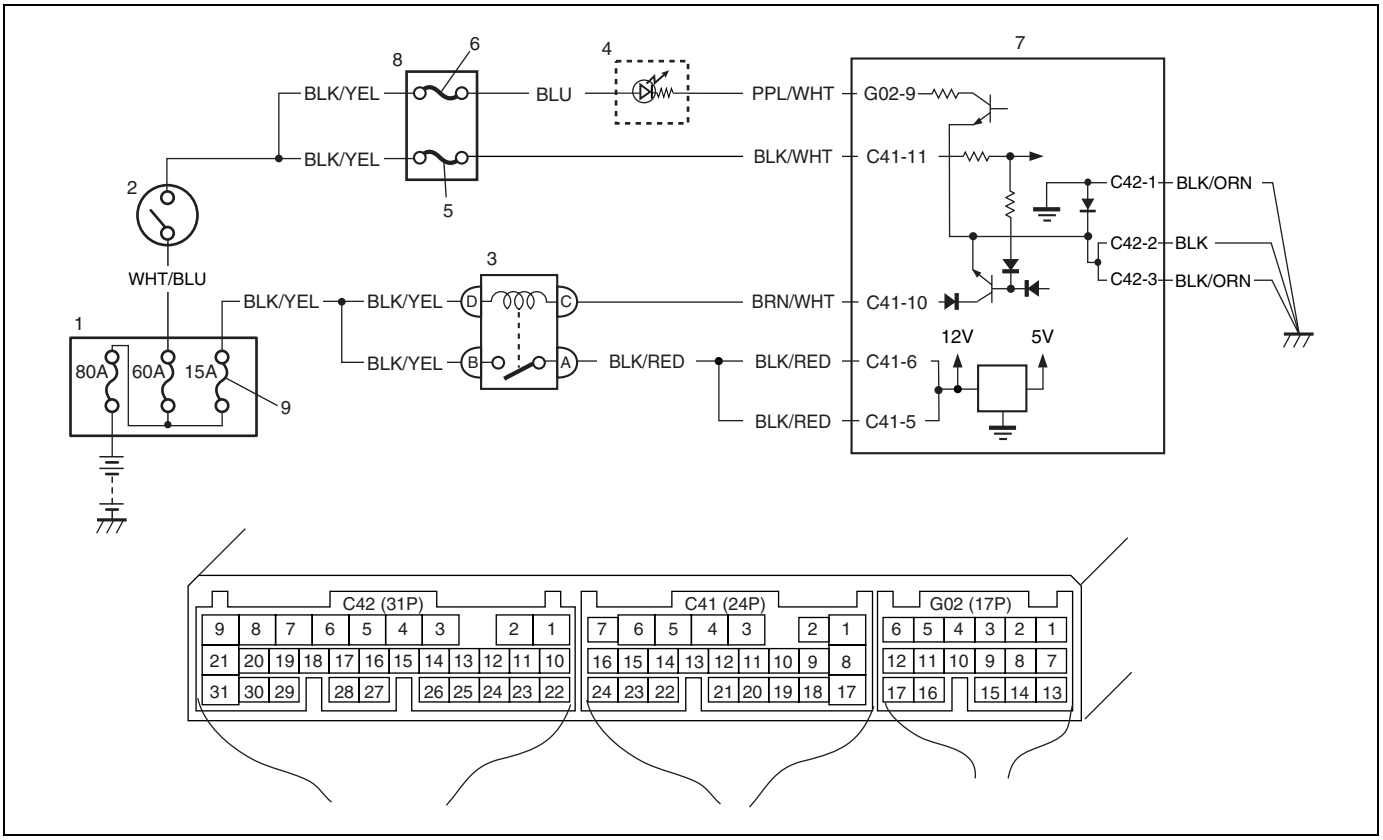
Table A-5 ECM Power and Ground Circuit Check-MIL Doesn't Light with Ignition Switch ON and Engine Doesn't Start Though It is Cranked Up

Wiring Diagram



1. Relay box	4. Malfunction indicator lamp in combination meter	7. ECM
2. Ignition switch	5. "IG" fuse	8. Circuit fuse box
3. Main relay	6. "METER" fuse	9. FI fuse

Circuit Description

When the ignition switch tuned ON, the main relay turns ON (the contact point closes) and the main power is supplied to ECM.

Troubleshooting

Step	Action	Yes	No
1	IG Fuse Check 1) Disconnect connectors from ECM with ignition switch turned OFF. 2) Check for proper connection to ECM connector at "G02-9", "C41-11", "C41-10", "C41-5", "C41-6", "C42-2" and "C42-3" wire terminals. 3) If OK, check "IG" fuse for fuse blow. Is "IG" fuse in good condition?	Go to Step 2.	Replace fuse and check for short in circuits connected to this fuse.
2	Ignition Signal Check 1) Turn ignition switch to ON position. 2) Measure voltage between "C41-11" wire terminal of ECM connector and body ground. Is voltage 10 – 14 V?	Go to Step 3.	"BLK/WHT" or "BLK/YEL" wire circuit open.

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Step	Action	Yes	No
3	Main Relay Circuit Check 1) Turn ignition switch to OFF position. 2) Check for fuse blow at FI fuse (15 A). (See Fig. 1.) 3) If OK, measure voltage between “C41-10” wire terminal of ECM connector and body ground. Is voltage 10 – 14 V?	Go to Step 4.	Go to Step 8.
4	Main Relay Circuit Check 1) Remove ECM from vehicle body and connect connectors to ECM. 2) Turn ignition switch to ON position. 3) Measure voltage between “C41-10” wire terminal of ECM connector and body ground. Is voltage 0 – 1 V?	Go to Step 6.	Go to Step 5.
5	ECM Ground Circuit Check 1) Turn ignition switch to OFF position. 2) Disconnect connectors from ECM. 3) Measure resistance between each “C42-1”, “C42-2” and “C42-3” wire terminals of ECM connector and body ground. Is resistance 1 Ω or less?	Substitute a known-good ECM and recheck.	“BLK/ORN” or “BLK” wire open circuit or high resistance circuit.
6	Main Relay Circuit Check 1) Disconnect connectors from ECM with ignition switch turned OFF. 2) Using service wire, ground “C41-10” wire terminal of ECM connector and measure voltage between each “C41-5” and “C41-6” wire terminals of ECM connector and body ground. Is voltage 10 – 14 V?	Substitute a known-good ECM and recheck.	Go to Step 7.
7	Main Relay Circuit Check 1) Remove main relay from relay box. (See Fig. 2.) 2) Check for proper connection to main relay connector at “BLK/YEL” and “BLK/RED” wire terminals. 3) If OK, measure resistance between each “C41-5” and “C41-6” wire terminals of ECM connector and “BLK/RED” wire terminal of main relay connector. Is resistance 1Ω or less?	Go to Step 8.	“BLK/RED” wire open circuit or high resistance circuit.
8	Main Relay Circuit Check 1) Remove main relay from relay box. 2) Measure voltage between “BLK/YEL” wire terminals of main relay connector and body ground. Is voltage 10 – 14 V?	Go to Step 9.	“BLK/YEL” wire circuit open.

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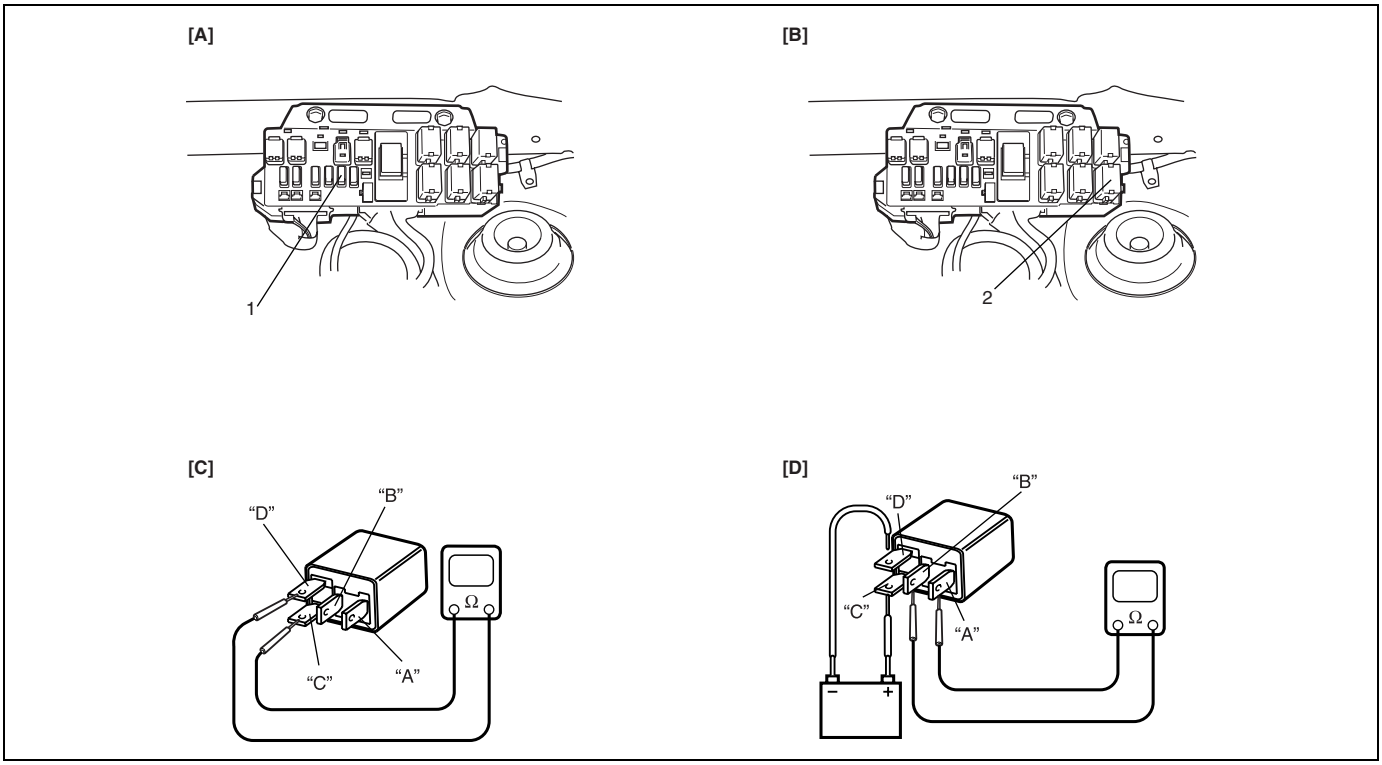
Step	Action	Yes	No
9	Main Relay Check 1) Measure resistance between each two terminals of main relay. (See Fig. 3). Between main relay terminals "A" and "B": Infinity "C" and "D": 160 – 240 Ω at 20°C (68°F) 2) Measure resistance between terminals "A" and "B" when battery is connected to terminals "C" and "D" (See Fig. 4). Between "A" and "B": Less than 1 Ω Is main relay in good condition?	"BRN/WHT" wire is open circuit or high resistance circuit.	Replace main relay.



[A]: Fig. 1 for Step 3	[C]: Fig. 3 for Step 9	1. FI fuse (15 A)
[B]: Fig. 2 for Step 7	[D]: Fig. 4 for Step 9	2. Main relay

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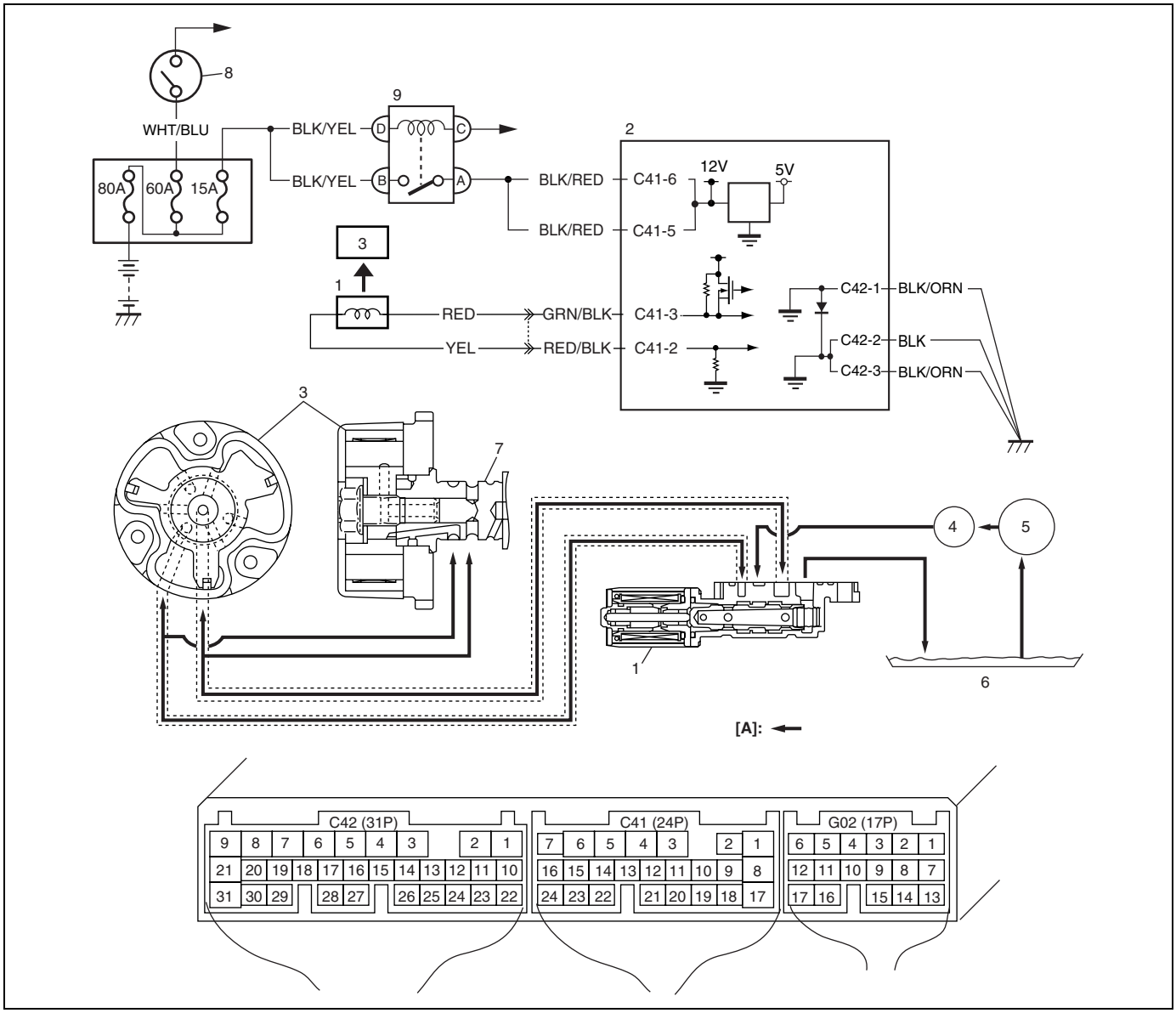
DTC P0010 Camshaft Position Actuator Circuit

System/Wiring Diagram



[A]: Oil flow	3. Camshaft timing sprocket	6. Oil pan	9. Main relay
1. Oil control valve	4. Oil filter	7. Intake camshaft	
2. ECM	5. Oil pump	8. Ignition switch	

Circuit Description

Actual valve timing fails to become close to target advance level of each function although advance control function or retarded advance control function is at work.

DTC Detecting Condition and Trouble Area

DTC Detecting Condition	Trouble Area
Monitor signal of oil control valve is different from command signal. (Circuit open or short) (1 driving cycle detection logic)	• Oil control valve • Oil control valve circuit • ECM

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DTC Confirmation Procedure

1) Clear DTC. Refer to “DTC Clearance”.
2) Start engine and keep it at idle for 10 seconds.
3) Check DTC. Refer “DTC Check”.

Troubleshooting

Step	Action	Yes	No
1	Was “Engine and Emission Control System Check” performed?	Go to Step 2.	Go to “Engine and Emission Control System Check” in this section.
2	Check oil control valve circuit 1) Disconnect connectors from ECM with ignition switch turned off. 2) Check for proper connection at C41-2 and C41-3 terminal of ECM connector. 3) If OK, measure resistance between C41-2 and C41-3 terminal of ECM connector. Is resistance less than 10 Ω?	Go to Step 3.	Go to Step 7.
3	Check oil control valve circuit Was resistance more than 6.5 Ω in Step 2?	Go to Step 4.	Go to Step 6.
4	Check oil control valve circuit for power short. 1) Turn on ignition switch. 2) Measure voltage between C41-3 terminal of ECM connector and vehicle body ground. Is voltage less than 1 V?	Go to Step 5.	“RED” or “GRN/BLK” wire is shorted to power supply circuit.
5	Check oil control valve circuit for ground short. 1) Disconnect connector from oil control valve with ignition switch turned off. 2) Measure resistance between C41-3 terminal of ECM connector and vehicle body ground. Is resistance infinity?	Go to Step 8.	“GRN/BLK” wire is shorted to ground circuit.
6	Check oil control valve circuit for ground short. 1) Disconnect connector from oil control valve with ignition switch turned off. 2) Measure resistance between C41-3 terminal and C41-2 terminal of ECM connector. Is resistance infinity?	Go to Step 8.	“GRN/BLK” wire is shorted to “RED/BLK” wire.
7	Check oil control valve circuit 1) Disconnect connector from oil control valve with ignition switch turned off. 2) Measure resistance between C41-3 terminal of ECM connector and “GRN/BLK” wire terminal of oil control valve connector and between C41-2 terminal of ECM connector and “RED/BLK” wire terminal of oil control valve connector. Is each resistance less than 1 Ω?	Go to Step 8.	“GRN/BLK” wire or “RED/BLK” wire circuit is open or high resistance.
8	Check oil control valve Check oil control valve referring to “Oil Control Valve Inspection” in Section 6E2. Is it in good condition?	Substitute a known good ECM and recheck	Faulty oil control valve.

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DTC P0011 Camshaft Position – Timing Over-Advanced or System Performance

DTC P0012 Camshaft Position – Timing Over-Retarded

Description

Actual value of advanced valve timing does not reach target value.
Valve timing is advanced although ECM command is most retarding.

DTC Detecting Condition and Trouble Area

DTC Detecting Condition	Trouble Area
Actual valve of advanced valve timing does not reach target value, or valve timing is advanced although ECM command is most retarding. (2 driving cycle detection logic)	• Oil control valve • Oil galleries of timing sprocket • Intake camshaft timing sprocket (VVT actuator)

DTC Confirmation Procedure

1) Clear DTC. Refer to “DTC Clearance”
2) Start engine and drive vehicle under usual driving condition for 5 minutes or longer until engine is warmed up to normal operating temperature.
3) Stop vehicle.
4) Run engine at idle speed for 1 minute.
5) Start vehicle and increase vehicle speed up to 80 km/h (50 mile/h).
6) Keep vehicle speed at 80 km/h (50 mile/h) for 1 minute or longer at 5th gear position.
7) Decrease vehicle speed gradually.
8) Stop vehicle and ignition switch OFF.
9) Repeat step 4) to 7) one time.
10) Stop vehicle.

Check DTC. Refer to “DTC Check” in this section.

Troubleshooting

Step	Action	Yes	No
1	Is DTC P0010 detected together?	Go to “DTC P0010 Camshaft Position Actuator Circuit” in this section.	Go to Step 2.
2	Do you have SUZUKI scan tool?	Go to Step 3.	Go to Step 5.
3	VVT GAP Check 1) With ignition switch turned OFF, connect SUZUKI scan tool. 2) Start engine and warm up to normal operating temperature. 3) Select menu to DATA LIST. 4) Check that the VVT GAP displayed on SUZUKI scan tool is 0 – 5°. Is it OK?	Go to Step 4.	Check valve timing referring to “2nd Timing Chain and Chain Tensioner Removal and Installation” in Section 6A1. If OK, go to Step 5.

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Step	Action	Yes	No
4	VVT Signal Check 1) Drive vehicle the following condition. • Vehicle speed at 80 km/h (50 mile/h). • Gear position at 5th. 2) Check that the VVT GAP displayed on SUZUKI scan tool is 0 – 5°. Is it OK?	Substitute a known-good ECM and recheck.	Go to Step 5.
5	Oil Control Circuit Visual Inspection 1) Remove cylinder head cover referring to “Cylinder Head Cover Removal and Installation” in Section 6A1. 2) Check oil pressure leakage from oil control circuit. Is it in good condition?	Go to Step 6.	Repair or replace.
6	Check Oil Control Circuit. 1) Remove oil control valve referring to “Oil Control Valve Removal and Installation” in Section 6A1. 2) Remove oil gallery pipe referring to “Oil Gallery Pipe Removal and Installation” in Section 6A1. 3) Check oil gallery pipe and oil control valve for clog or sludge. Is it in good condition?	Go to Step 7.	Clean oil control valve and oil gallery pipe. Replace oil control valve if a problem is not solved after cleaning oil control valve and oil gallery pipe.
7	Check Oil Control Valve 1) Check oil control valve referring to “Oil Control Valve Inspection” in Section 6E2. Is it in good condition?	Replace camshaft timing sprocket.	Replace oil control valve.

NOTE:

Upon completion of inspection and repair work, perform “DTC Confirmation Procedure” and confirm that the trouble has been corrected.

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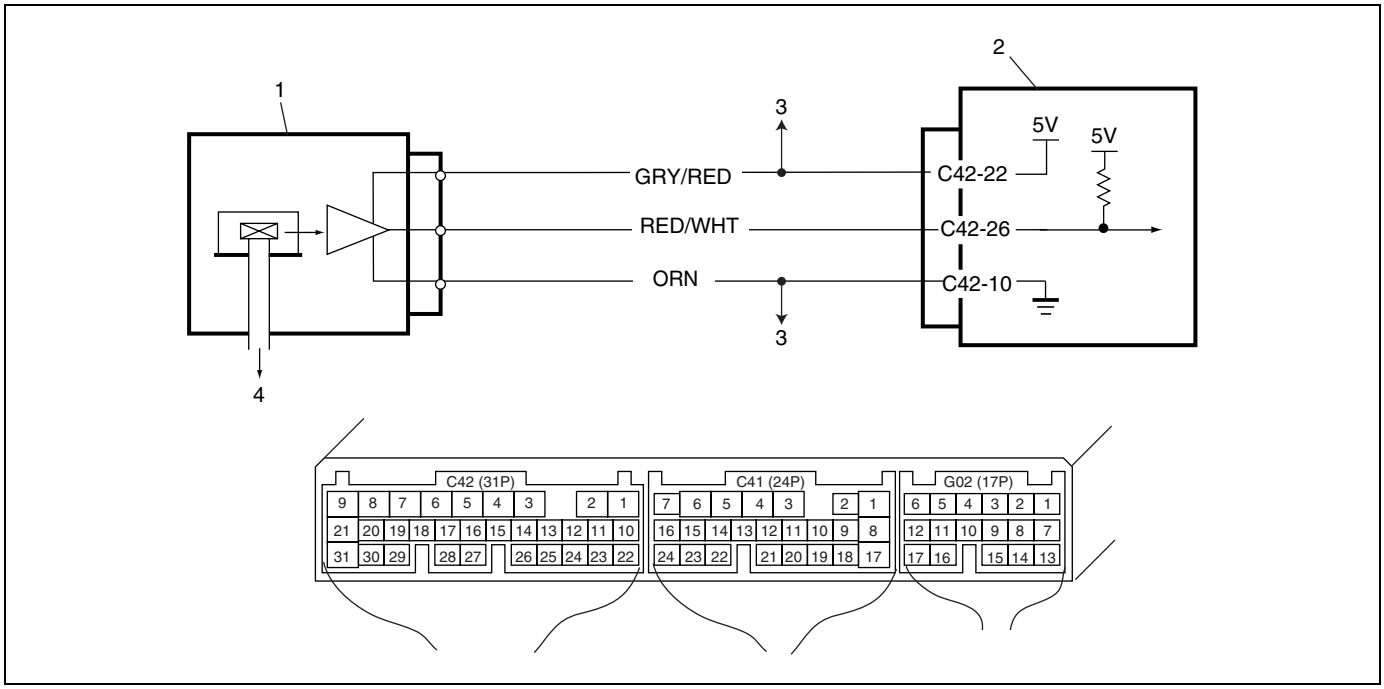
DTC P0105 (DTC No.11) Manifold Absolute Pressure (MAP) Circuit Malfunction

Wiring Diagram



1. MAP sensor	3. To other sensors
2. ECM	4. Manifold pressure

DTC Detecting Condition and Trouble Area

DTC Detecting Condition	Trouble Area
• MAP sensor signal is 0.19 V or lower (Low pressure – High vacuums – Low voltage) or • MAP sensor signal is 4.5 V or higher (High pressure – Low vacuums – High voltage)	• "ORN" circuit open • "GRY/RED" circuit open or shorted to ground • "RED/WHT" circuit open or shorted to ground • MAP sensor malfunction • ECM malfunction

NOTE:

- **When this DTC and DTC P0120 (No.13) are indicated together, it is possible that "GRY/RED" circuit is open.**
- **When DTC P0105 (No.11), P0110 (No.18), P0115 (No.19) and P0120 (No.13) are indicated together, it is possible that "ORN" circuit is open.**

DTC Confirmation Procedure

1) Clear DTC, start engine and keep it at idle for 1 min.
2) Select "DTC" mode on scan tool and check DTC.

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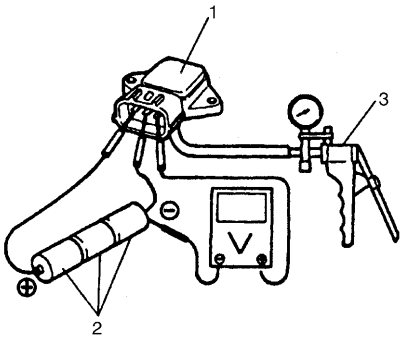
MAP Sensor Individual Check



1) Disconnect connector from MAP sensor (1).
2) Remove MAP sensor (1).
3) Arrange 3 new 1.5 V batteries (2) in series (check that total voltage is 4.5 – 5.0 V) and connect its positive terminal to "Vin" terminal of sensor and negative terminal to "Ground" terminal. Then check voltage between "Vout" and "Ground". Also, check if voltage reduces when vacuum is applied up to 400 mmHg by using vacuum pump (3).

Output voltage (When input voltage is 4.5 – 5.5 V, ambient temp. 20 – 30°C, 68 – 86°F)

ALTITUDE (Reference)		BAROMETRIC PRESSURE		OUTPUT VOLTAGE
(ft)	(m)	(mmHg)	(kPa)	(V)
0 | 2 000	0 | 610	760 | 707	100 | 94	3.3 – 4.3
2 001 | 5 000	611 | 1 524	Under 707 over 634	94 | 85	3.0 – 4.1
5 001 | 8 000	1 525 | 2 438	Under 634 over 567	85 | 76	2.7 – 3.7
8 001 | 10 000	2 439 | 3 048	Under 567 over 526	76 | 70	2.5 – 3.3

If check result is not satisfactory, replace MAP sensor (1).

4) Install MAP sensor (1) securely.
5) Connect MAP sensor (1) connector securely.

Troubleshooting

Step	Action	Yes	No
1	Was "Engine and Emission Control System Check" performed?	Go to Step 2.	Go to "Engine and Emission Control System Check".
2	Check MAP Sensor and Its Circuit. 1) Connect scan tool (1) to DLC (2) with ignition switch OFF. See Fig. 1. 2) Turn ignition switch ON. 3) Check intake manifold pressure. Is it 114 kPa or more or 43 kPa or less?	Go to Step 3.	Intermittent trouble. Check for intermittent referring to "Intermittent and Poor Connection" in Section 0A.

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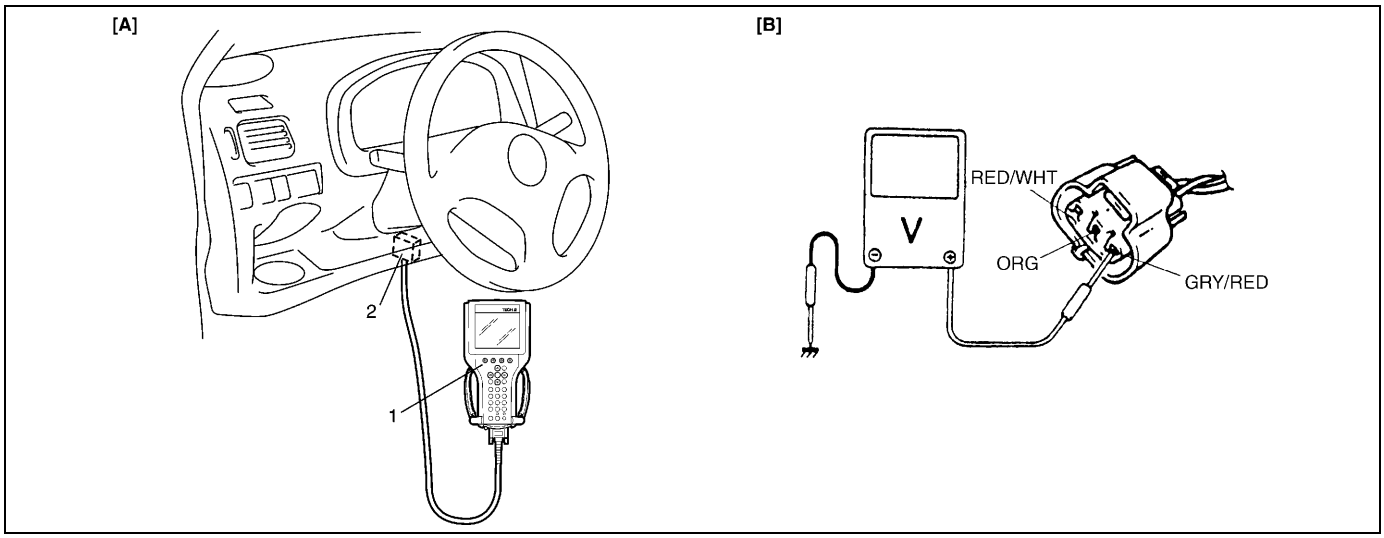
Step	Action	Yes	No
3	Check Wire Harness. 1) Disconnect MAP sensor connector with ignition switch OFF. 2) Check for proper connection of MAP sensor at "RED/WHT" and "GRY/RED" wire terminals. 3) If OK, then with ignition switch ON, check voltage between each of "GRY/RED" or "RED/WHT" wire terminals and body ground. See Fig. 2. Is voltage about 4 – 6 V at each terminal?	Go to Step 4.	"GRY/RED" wire open or shorted to ground circuit or shorted to power circuit (See NOTE), "RED/WHT" wire open or shorted to ground, poor C42-26 connection or C42-22 connection. If wire and connection are OK, confirm that MAP sensor is normal and then substitute a known-good ECM and recheck.
4	Check MAP sensor. Check MAP sensor according to "MAP Sensor Individual Check" mentioned previously. Is it in good condition?	"GRY/RED" wire shorted to "ORN" wire, "RED/WHT" wire open, poor C42-10 connection. If wire and connection are OK, substitute a known-good ECM and recheck.	Replace MAP sensor.

NOTE:

When battery voltage is applied to "GRY/RED" wire, it is possible that MAP sensor is also faulty.



[A]: Fig. 1 for Step 2
[B]: Fig. 2 for Step 3

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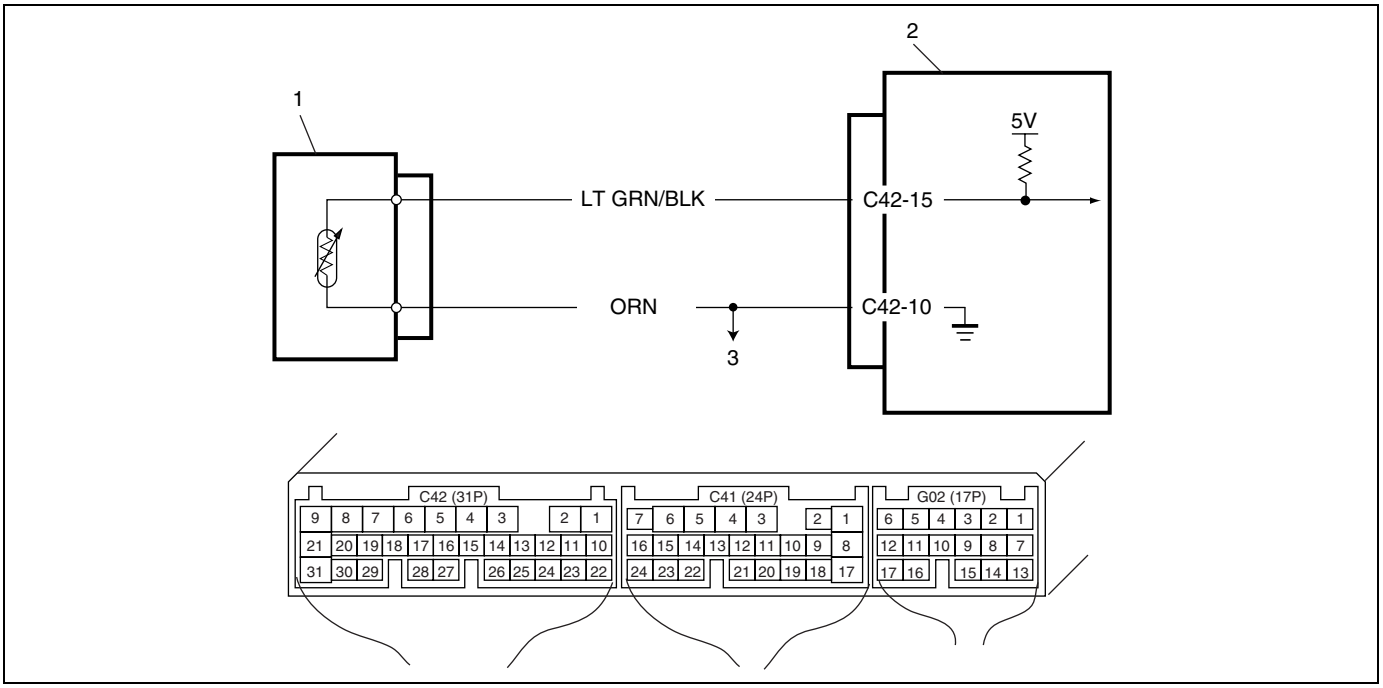
DTC P0110 (DTC No.18) Intake Air Temp. (IAT) Circuit Malfunction

Wiring Diagram



1. IAT sensor	3. To other sensors
2. ECM	

DTC Detecting Condition and Trouble Area

DTC Detecting Condition	Trouble Area
• Low intake air temperature (High voltage-High resistance) or • High intake air temperature (Low voltage-Low resistance)	• "LT GRN/BLK" circuit open or shorted to power. • "ORN" circuit open • IAT sensor malfunction • ECM malfunction

NOTE:

- **When DTC P0105 (No.11), P0110 (No.18), P0115 (No.19) and P0120 (No.13) are indicated together, it is possible that "ORN" circuit is open.**
- **Before inspecting, be sure to check that ambient temperature is higher than – 40°C (– 40°F).**

DTC Confirmation Procedure

1) Clear DTC, start engine and keep it at idle for 1 min.
2) Select "DTC" mode no scan tool and check DTC.

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Troubleshooting

Step	Action	Yes	No
1	Was “Engine and Emission Control System Check” performed?	Go to Step 2.	Go to “Engine and Emission Control System Check”.
2	Check IAT Sensor and Its Circuit. 1) Connect scan tool (1) to DLC (2) with ignition switch OFF. 2) Turn ignition switch ON. 3) Check intake air temp. displayed on scan tool. See Fig. 1. Is – 40°C (– 40°F) or 119°C (246°F) indicated?	Go to Step 3.	Intermittent trouble. Check for intermittent referring to “Intermittent and Poor Connection” in Section 0A.
3	Check Wire Harness. 1) Disconnect IAT sensor connector with ignition switch OFF. 2) Check for proper connection to IAT sensor at “LT GRN/BLK” and “ORN” wire terminals. 3) If OK, then with ignition switch ON, is voltage applied to “LT GRN/BLK” wire terminal about 4 – 6 V? See Fig. 2.	Go to Step 5.	“LT GRN/BLK” wire is open or shorted to power, or poor C42-15 connection. If wire and connection are OK, substitute a known-good ECM and recheck.
4	Does scan tool indicate – 40°C (– 40°F) at Step 2.	Go to Step 6.	Go to Step 5.
5	Check Wire Harness 1) Check intake air temp. displayed on scan tool with ignition switch ON. Is – 40°C (– 40°F) indicated?	Replace IAT sensor.	“LT GRN/BLK” wire shorted to ground. If wire is OK, substitute a known-good ECM and recheck.
6	Check Wire Harness. 1) Using service wire, connect IAT sensor connector terminals. 2) Check intake air temp. displayed on scan tool with ignition switch ON. See Fig. 3. Is 119°C (246°F) indicated?	Replace IAT sensor.	“LT GRN/BLK” wire open or poor C42-10 connection. If wire and connection are OK, substitute a known-good ECM and recheck.

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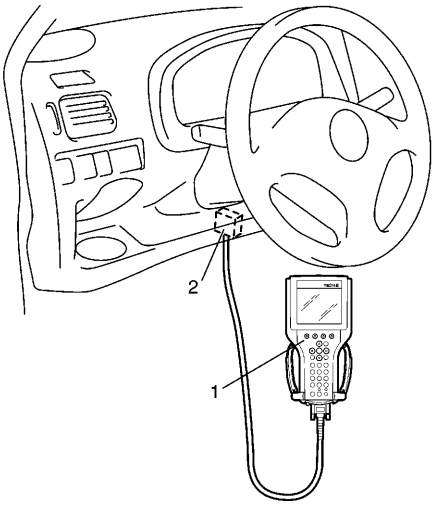
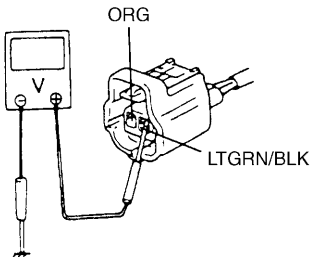
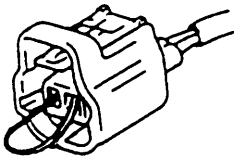
[A]



[B]



[C]



[A]: Fig. 1 for Step 2
[B]: Fig. 2 for Step 3
[C]: Fig. 3 for Step 4

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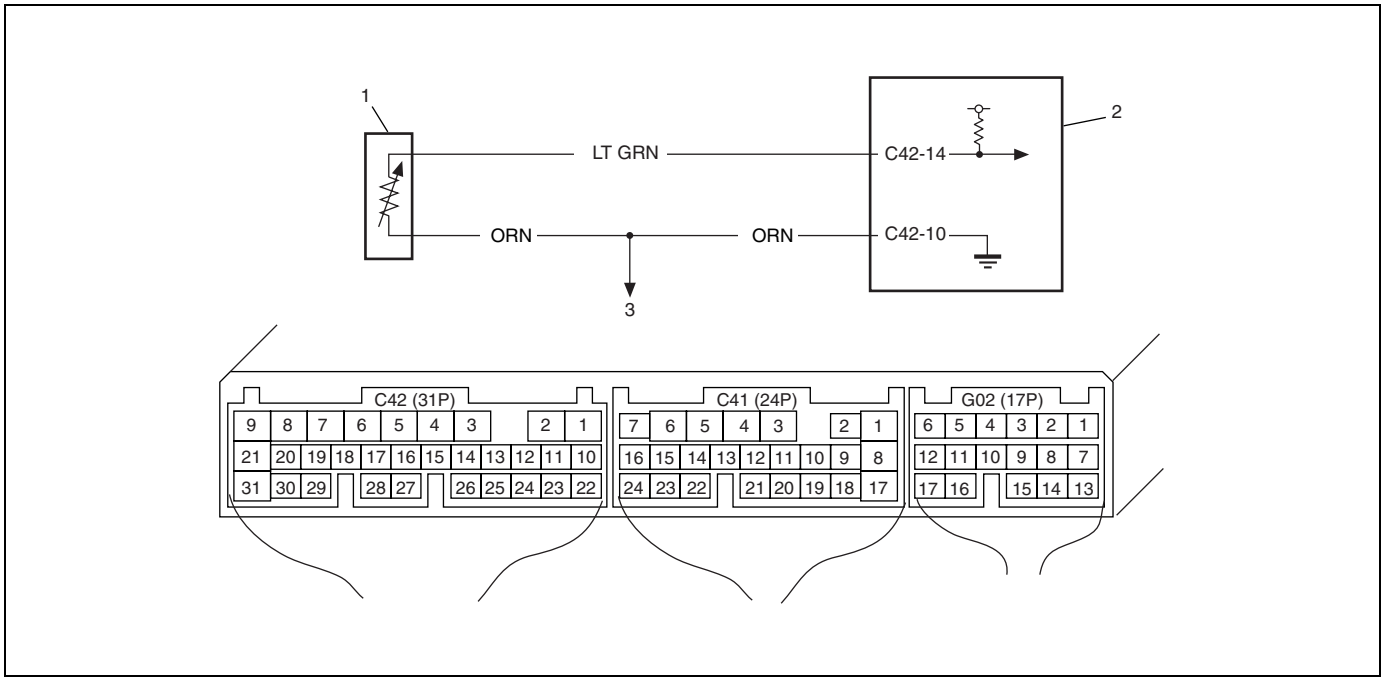
DTC P0115 (DTC No.19) Engine Coolant Temperature (ECT) Circuit Malfunction

Wiring Diagram



1. ECT sensor	3. To other sensors
2. ECM	

DTC Detecting Condition and Trouble Area

DTC Detecting Condition	Trouble Area
• Low engine coolant temperature (High voltage-High resistance) or • High engine coolant temperature (Low voltage-Low resistance)	• "LT GRN" circuit open or shorted to power • "ORN" circuit open • ECT sensor malfunction • ECM malfunction

NOTE:

- **Before inspecting, be sure to check that coolant temp. meter in combination meter indicates normal operating temperature (Engine is not overheating).**
- **When DTC P0105 (No.11), P0110 (No.18), P0115 (No.19) and P0120 (No.13) are indicated together, it is possible that "ORN" circuit open.**

DTC Confirmation Procedure

1) Clear DTC, start engine and keep it at idle for 1 min.
2) Select "DTC" mode no scan tool and check DTC.

Troubleshooting

Step	Action	Yes	No
1	Was "Engine and Emission Control System Check" performed?	Go to Step 2.	Go to "Engine and Emission Control System Check".

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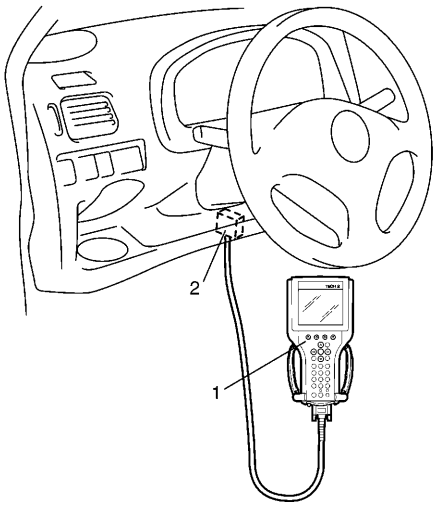
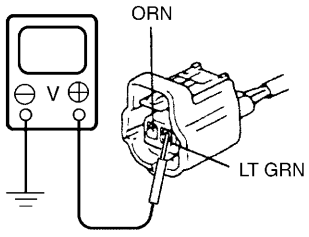
Step	Action	Yes	No
2	Check ECT Sensor and its Circuit. 1) Connect scan tool (1) to DLC (2) with ignition switch OFF. 2) Turn ignition switch ON. 3) Check engine coolant temp. displayed on scan tool. See Fig. 1. Is – 40°C (– 40°F) or 119°C (246°F) indicated?	Go to Step 3.	Intermittent trouble. Check for intermittent referring to “Intermittent and Poor Connection” in Section 0 A.
3	Check Wire Harness. 1) Disconnect ECT sensor connector. 2) Check engine coolant temp. displayed on scan tool. Is – 40°C (– 40°F) indicated?	Replace ECT sensor.	“LT GRN” wire shorted to ground. If wire is OK, substitute a known-good ECM and recheck.
4	Does scan tool indicate – 40°C (– 40°F) at Step 2.	Go to Step 6.	Go to Step 5.
5	Check Wire Harness. 1) Disconnect ECT sensor connector with ignition switch OFF. 2) Check for proper connection to ECT sensor at “ORN” and “LT GRN” wire terminals. If OK, then with ignition switch ON, is voltage applied to “LT GRN” wire terminal about 4 – 6 V? See Fig. 2.	Go to Step 4.	“LT GRN” wire open or shorted to power, or poor C42-14 connection. If wire and connection are OK, substitute a known-good ECM and recheck.
6	Check Wire Harness. 1) Using service wire, connect ECT sensor connector terminals. See Fig. 3. 2) Turn ignition switch ON and check engine coolant temp. displayed on scan tool. Is 119°C (246°F) indicated?	Replace ECT sensor.	“ORN” wire open or poor C42-10 connection. If wire and connection are OK, substitute a known-good ECM and recheck.

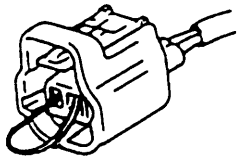
[A]



[B]



[C]



[A]: Fig. 1 for Step 2
[B]: Fig. 2 for Step 3
[C]: Fig. 3 for Step 4

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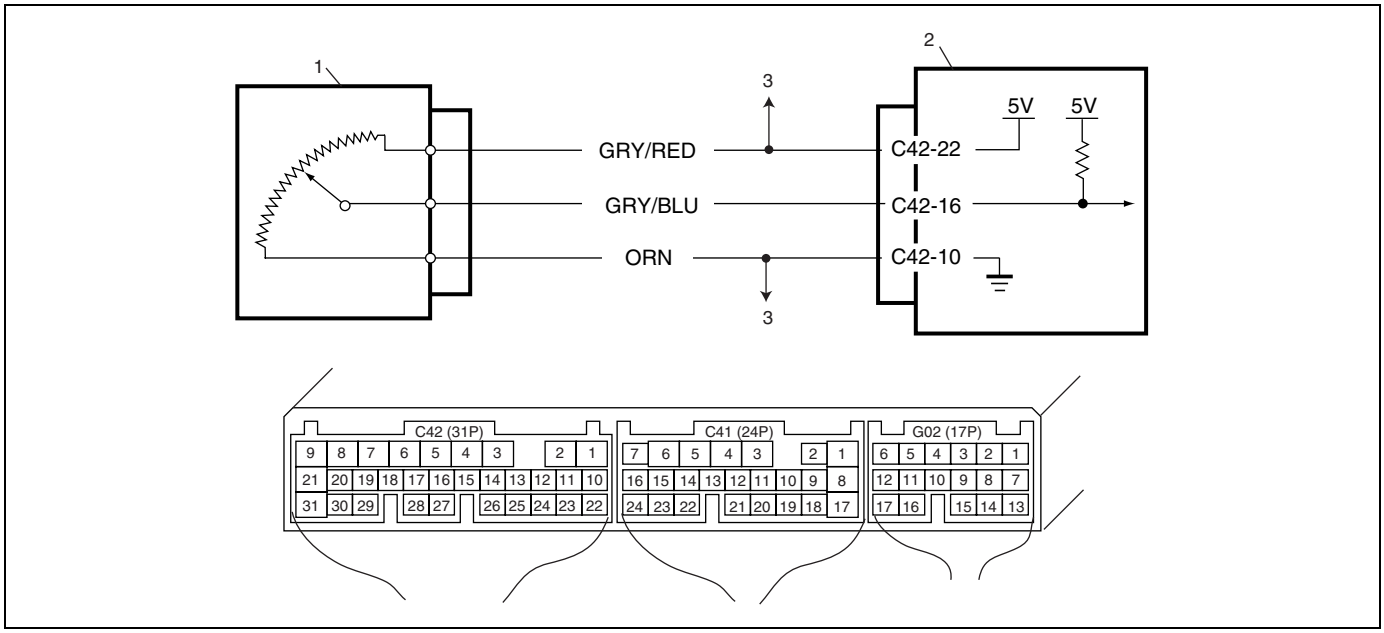
DTC P0120 (DTC No.13) Throttle Position Circuit Malfunction

Wiring Diagram



1. TP sensor	3. To other sensors
2. ECM	

DTC Detecting Condition and Trouble Area

DTC Detecting Condition	Trouble Area
• Signal voltage high or • Signal voltage low	• "ORN" circuit open • "GRY/BLU" circuit open or shorted to ground • "GRY/RED" circuit open or shorted to power or ground • TP sensor malfunction • ECM malfunction

NOTE:

- **When DTC P0105 (No.11), P0110 (No.18), P0115 (No.19) and P0120 (No.13) are indicated together, it is possible that "ORN" or "GRY/RED" circuit is open.**
- **When this DTC and DTC P0105 (No.11) are indicated together, it is possible that "GRY/RED" circuit is open.**

DTC Confirmation Procedure

1) Clear DTC, start engine and keep it at idle for 1 min.
2) Select "DTC" mode no scan tool and check DTC.

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Troubleshooting

Step	Action	Yes	No
1	Was “Engine and Emission Control System Check” performed?	Go to Step 2.	Go to “Engine and Emission Control System Check”.
2	Check TP Sensor and Its Circuit. 1) Connect scan tool (1) to DLC (2) with ignition switch OFF and then turn ignition switch ON. 2) Check throttle valve opening percentage displayed on scan tool. See Fig. 1. Is it displayed 2% or less? 3) Check throttle valve opening percentage displayed on scan tool while opening throttle valve from idle position to full open position. See Fig. 1. Is it displayed 96% or higher?	Go to Step 3.	Intermittent trouble. Check for intermittent referring to “Intermittent and Poor Connection” in Section 0 A.
3	Check Wire Harness. 1) Disconnect connector from TP sensor with ignition switch OFF. 2) Check for proper connection to TP sensor at “GRY/RED”, “GRY/BLU” and “ORN” wire terminals. 3) If OK, then with ignition switch ON, check voltage between each of “GRY/RED” or “GRY/BLU” wire terminals and body ground. See Fig. 2. Is voltage about 4 – 6 V at each terminal?	Go to Step 4.	“GRY/RED” wire open, “GRY/RED” wire shorted to ground circuit or power circuit or “GRY/BLU” wire, “ORN” wire open or shorted to ground circuit or poor C42-22 or C42-16 connection. If wire and connection are OK, substitute a known-good ECM and recheck.
4	Check TP Sensor. 1) Check resistance between terminals of TP sensor referring to “Throttle position sensor on-vehicle inspection” in Section 6E2. See Fig. 3. Are measured values within specifications?	“ORN” wire open or poor C42-10 connection. If wire and connection are OK, substitute a known-good ECM and recheck.	Replace TP sensor.

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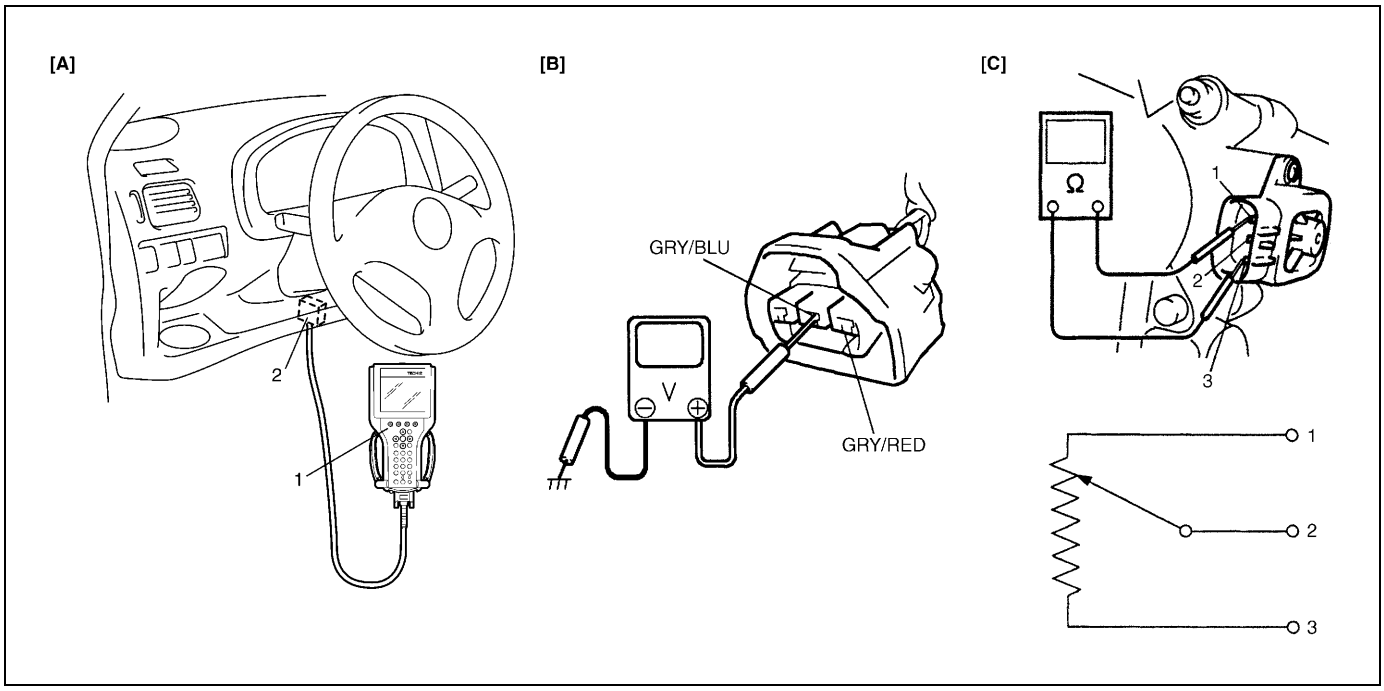

[A]: Fig. 1 for Step 2
[B]: Fig. 2 for Step 3
[C]: Fig. 3 for Step 4

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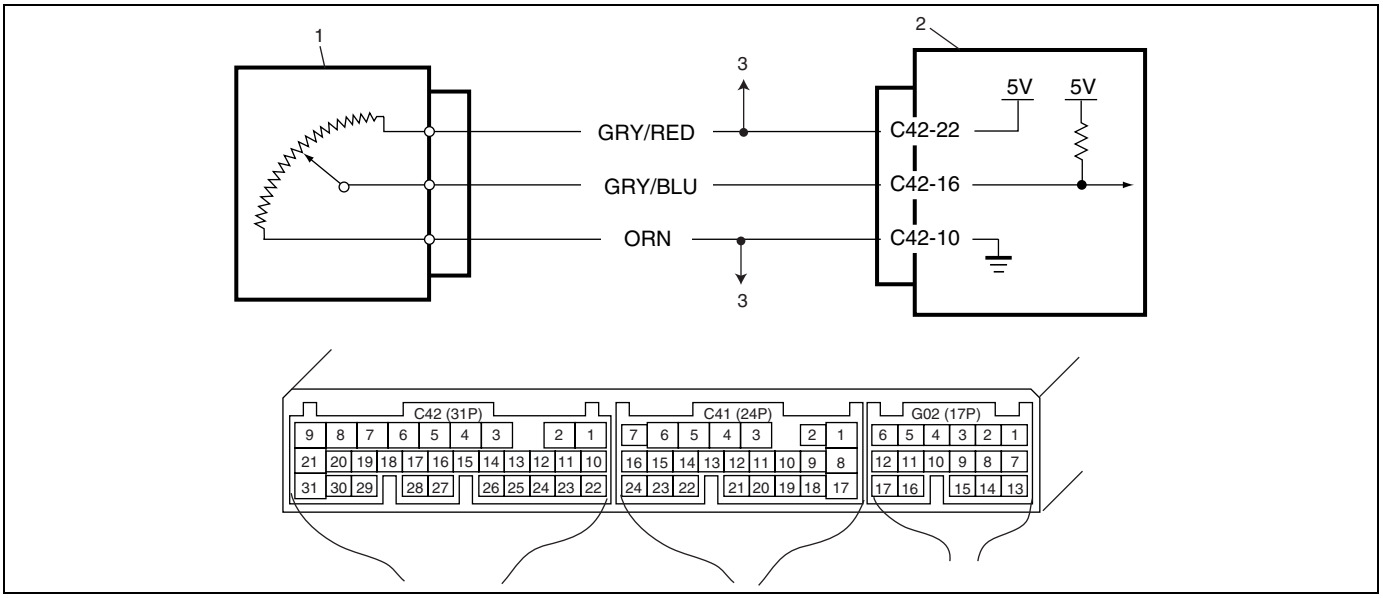
DTC P0121 Throttle Position Circuit Range/Performance Problem

Wiring Diagram



1. TP sensor	3. To other sensors
2. ECM	

DTC Detecting Condition and Trouble Area

DTC Detecting Condition	Trouble Area
• DTC will set when the following conditions are detected. • After engine warmed up. • While vehicle running at specified engine speed. • No change in intake manifold pressure (constant throttle opening) • Difference between actual throttle opening (detected from TP sensor) and opening calculated by ECM (Obtained on the basis of engine speed and intake manifold pressure) in larger than specified value. ✱2 driving cycle detection logic, continuous monitoring	• TP sensor malfunction • High resistance in the circuit • ECM malfunction

DTC Confirmation Procedure

WARNING:
- **When performing a road test, select a place where there is no traffic or possibility of a traffic accident and be very careful during testing to avoid occurrence of an accident.**
- **Road test should be carried out with 2 persons, a driver and a tester, on a level road.**

1) Turn ignition switch OFF. Clear DTC with ignition switch ON, check vehicle and environmental condition for:
   – Altitude (barometric pressure): 2400 m, 8000 ft or less (560 mmHg, 75 kPa or more)
   – Ambient temp.: –10°C, 14°F or higher
   – Intake air temp.: 70°C, 158°F or lower
   – Engine coolant temp.: 70 – 110°C, 158 – 230°F
2) Warm up engine to normal operating temperature.
3) Increase vehicle speed to 30 – 40 mph, 50 – 60 km/h in 3rd gear or “D” range and hold throttle valve at that opening position for 1 min.
4) Stop vehicle.
5) Check DTC in “DTC” mode and pending DTC in “ON BOARD TEST” or “PENDING DTC” mode.

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Troubleshooting

Step	Action	Yes	No
1	Was “Engine and Emission Control System Check” performed?	Go to Step 2.	Go to “Engine and Emission Control System Check”.
2	Is SUZUKI scan tool available?	Go to Step 3.	Go to Step 4.
3	Check TP Sensor and its Circuit. 1) Turn ignition switch OFF and connect SUZUKI scan (1) tool to DLC (2). 2) Turn ignition switch ON and check TP sensor output voltage when throttle valve is at idle position and fully opened. See Fig. 1 and 3. Dose voltage vary within specified value linearly as shown in figure?	If voltmeter was used, check terminal C42-16 for poor connection. If OK, substitute a known-good ECM and recheck.	Go to Step 5.
4	Check TP Sensor and Its Circuit. 1) Turn ignition switch ON. 2) Check voltage at terminal C42-16 of ECM connector connected, when throttle valve is at idle position and fully opened. See Fig. 2 and 3. Dose voltage vary within specified value linearly as shown in figure?	If voltmeter was used, check terminal C42-16 for poor connection. If OK, substitute a known-good ECM and recheck.	Go to Step 5.
5	Check TP Sensor. 1) Turn ignition switch OFF. 2) Disconnect TP sensor connector. 3) Check for proper connection to TP sensor at each terminal. 4) If OK, then measure resistance between terminals of TP sensor referring to “Throttle position sensor on-vehicle inspection” in Section 6E2. See Fig. 4. Are measured values as specified?	High resistance in “GRY/RED”, “GRY/BLU” or “ORN” circuit. If wire and connection are OK, substitute a known-good ECM and recheck.	Replace TP sensor.

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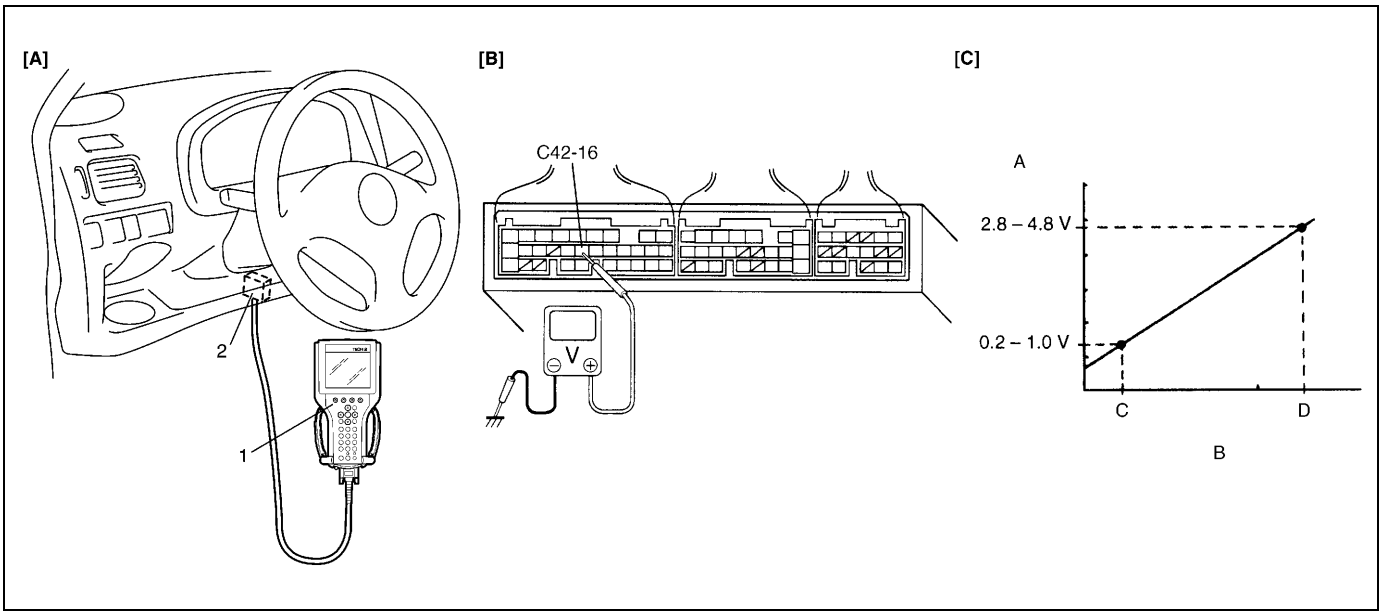
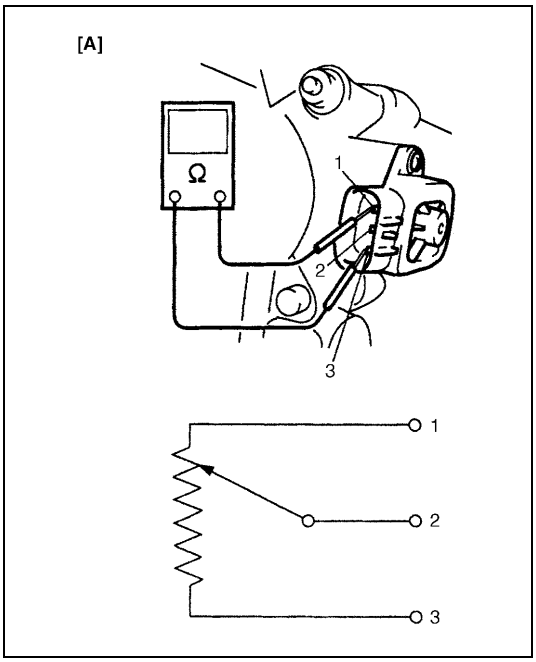


[A]: Fig. 1 for Step 2	A. TP sensor output voltage	D. Fully open
[B]: Fig. 2 for Step 3	B. Throttle opening	
[C]: Fig. 3 for Step 4	C. Closed (at idle)	



[A]: Fig. 4 for Step 5

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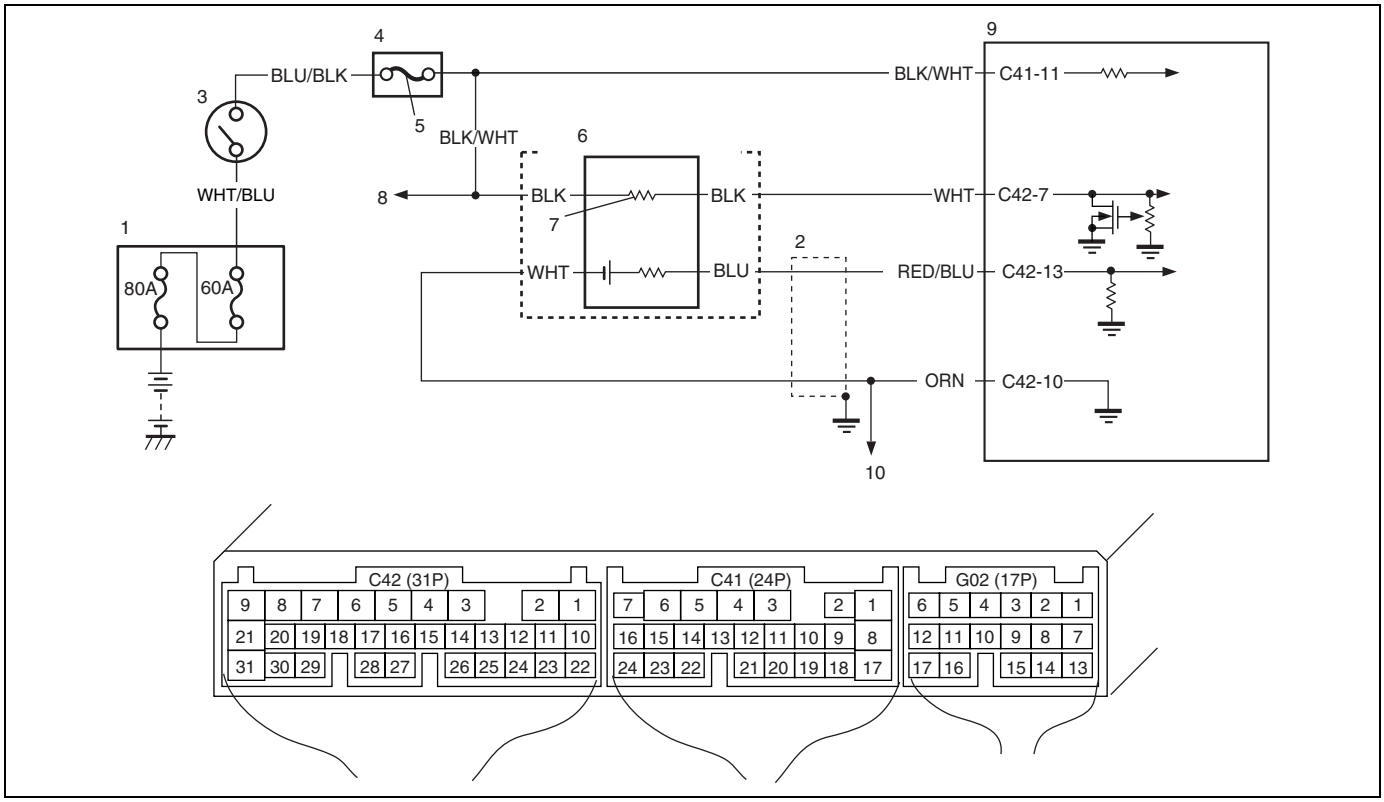
DTC P0130 (DTC No.14) Heated Oxygen Sensor (HO2S) Circuit Malfunction (Sensor-1)

Wiring Diagram



1. Relay box	3. Ignition switch	5. "IG" fuse	7. Heater	9. ECM
2. Shield wire	4. Circuit fuse box	6. HO2S–1	8. To HO2S–2 heater	10. To other sensors

DTC Detecting Condition and Trouble Area

DTC Detecting Condition	Trouble Area
• When running at idle speed after engine warmed up and running at specified vehicle speed, HO2S–1 output voltage does not go below 0.3 V or over 0.6 V. ✱2 driving cycle detection logic, Monitoring once/1 driving.	• Heated oxygen sensor-1 malfunction • "WHT" or "ORN" circuit open (poor connection) or short

DTC Confirmation Procedure

WARNING:
- **When performing a road test, select a place where there is no traffic or possibility of a traffic accident and be very careful during testing to avoid occurrence of an accident.**
- **Road test should be carried out with 2 persons, a driver and a tester.**

1) Turn ignition switch OFF. Clear DTC with ignition switch ON, check vehicle and environmental condition for:
   – Altitude (barometric pressure): 2400 m, 8000 ft or less (560 mmHg, 75 kPa or more)
   – Ambient temp.: –10°C, 14°F or higher
   – Intake air temp.: 70°C, 158°F or lower
2) Warm up engine to normal operating temperature.
3) Drive vehicle at 30 – 40 mph, 50 – 60 km/h for 2 min.
4) Stop vehicle and run engine at idle for 2 min.
5) Check DTC in "DTC" mode and pending DTC in "ON BOARD TEST" or "PENDING DTC" mode.

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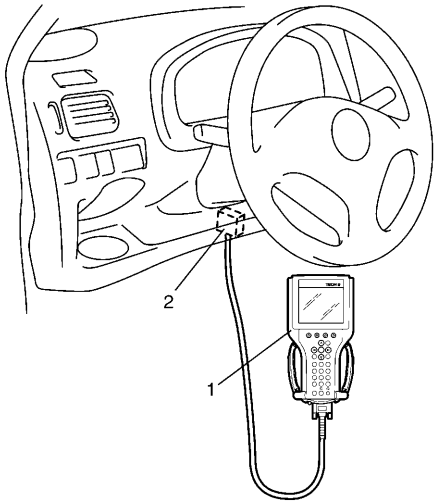
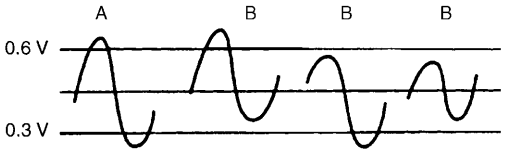
Troubleshooting

Step	Action	Yes	No
1	Was “Engine and Emission Control System CHeck” performed?	Go to Step 2.	Go to “Engine and Emission Control System Check”.
2	Is there DTC(s) other than HO2S–1 (DTC P0130)?	Go to applicable DTC Diag. Flow Table.	Go to Step 3.
3	Check HO2S–1 signal. 1) Connect scan tool (1) to DLC (2) with ignition switch OFF. 2) Warm up engine to normal operating temperature and keep it at 2000 r/min. for 60 sec. 3) Repeat racing engine (Repeat depressing accelerator pedal 5 to 6 times continuously and take foot off from pedal to enrich and enlean A/F mixture). See Fig. 1 and 2. Does HO2S–1 output voltage deflect between 0.3 V and over 0.6 V repeatedly?	Intermittent trouble. Check for intermittent referring to “Intermittent and Poor Connection” in Section 0A.	Check “WHT” and “ORN” wires for open and short, and connections for poor connection. If wires and connections are OK, replace HO2S–1.

[A]



[B]



[A]: Fig. 1 for Step 3
[B]: Fig. 2 for Step 3
A. Normal
B. NG

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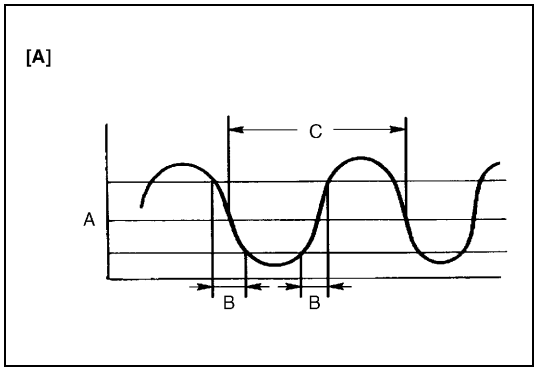
DTC P0133 Heated Oxygen Sensor (HO2S) Circuit Slow Response (Sensor-1)

Wiring Diagram

Refer to DTC P0130 section.

DTC Detecting Condition and Trouble Area

DTC Detecting Condition	Trouble Area
• When running at specified idle speed after engine warmed up and running at specified vehicle speed, response time (time to change from lean to rich or from rich to lean) of HO2S–1 output voltage is about 1 sec. at minimum or average time of 1 cycle is 5 sec. at minimum. See. Fig. 1 ✱2 driving cycle detection logic, Monitoring once/1 driving.	• Heated oxygen sensor-1 malfunction



[A]: Fig. 1
A. HO2S–1 output voltage
B. Response time
C. 1 cycle time

DTC Confirmation Procedure

Refer to DTC P0130 section.

Troubleshooting

Step	Action	Yes	No
1	Was “Engine and Emission Control System Check” performed?	Go to Step 2.	Go to “Engine and Emission control system Check”.
2	Is there DTC(s) other than HO2S–1 (DTC P0133)?	Go to applicable DTC Diag. Flow Table.	Replace HO2S–1.

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DTC P0134 Heated Oxygen Sensor (HO2S) Circuit No Activity Detected (Sensor-1)

Wiring Diagram

Refer to DTC P0130 section.

DTC Detecting Condition and Trouble Area

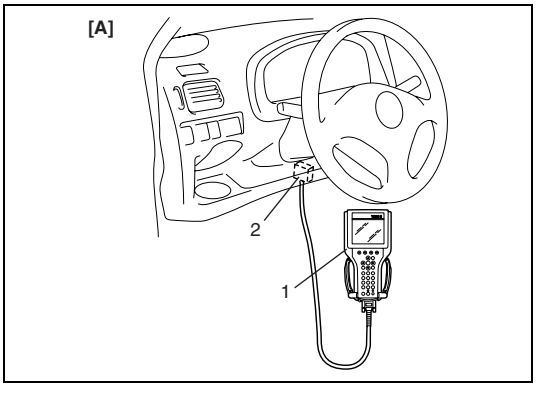
DTC Detecting Condition	Trouble Area
• Engine warmed up. • While running under other than high load and high engine speed conditions or at specified idle speed (engine is in closed loop condition), HO2S–1 output voltage is high or low continuously. ✱2 driving cycle detection logic, Continuous monitoring.	• "WHT" or "ORN" circuit open or short • Heated oxygen sensor malfunction • Fuel system malfunction • Exhaust gas leakage

DTC Confirmation Procedure

Refer to DTC P0131 section.

Troubleshooting

Step	Action	Yes	No
1	Was "Engine and Emission Control System Check" performed?	Go to Step 2.	Go to "Engine and Emission Control System Check".
2	Is there DTC(s) other than Fuel system (DTC P0171/P0172) and HO2S–1 (DTC P0134)?	Go to applicable DTC Diag. Flow Table.	Go to Step 3.
3	Check HO2S–1 and Its Circuit. 1) Connect scan tool (1) to DLC (2) with ignition switch OFF. 2) Warm up engine to normal operating temperature and keep it at 2000 r/min. for 60 sec. 3) Repeat racing engine (Repeat depressing accelerator pedal 5 to 6 times continuously and take foot off from pedal to enrich and enlean A/F mixture). See Fig. 1. Does HO2S–1 output voltage deflect between 0.3V and over 0.6V repeatedly?	Go to DTC P0171 and P0172 Diag. Flow Table (Fuel System Check).	Check "WHT" and "ORN" wires for open and short, and connections for poor connection. If wires and connections are OK, replace HO2S–1.



[A]: Fig. 1 for Step 3

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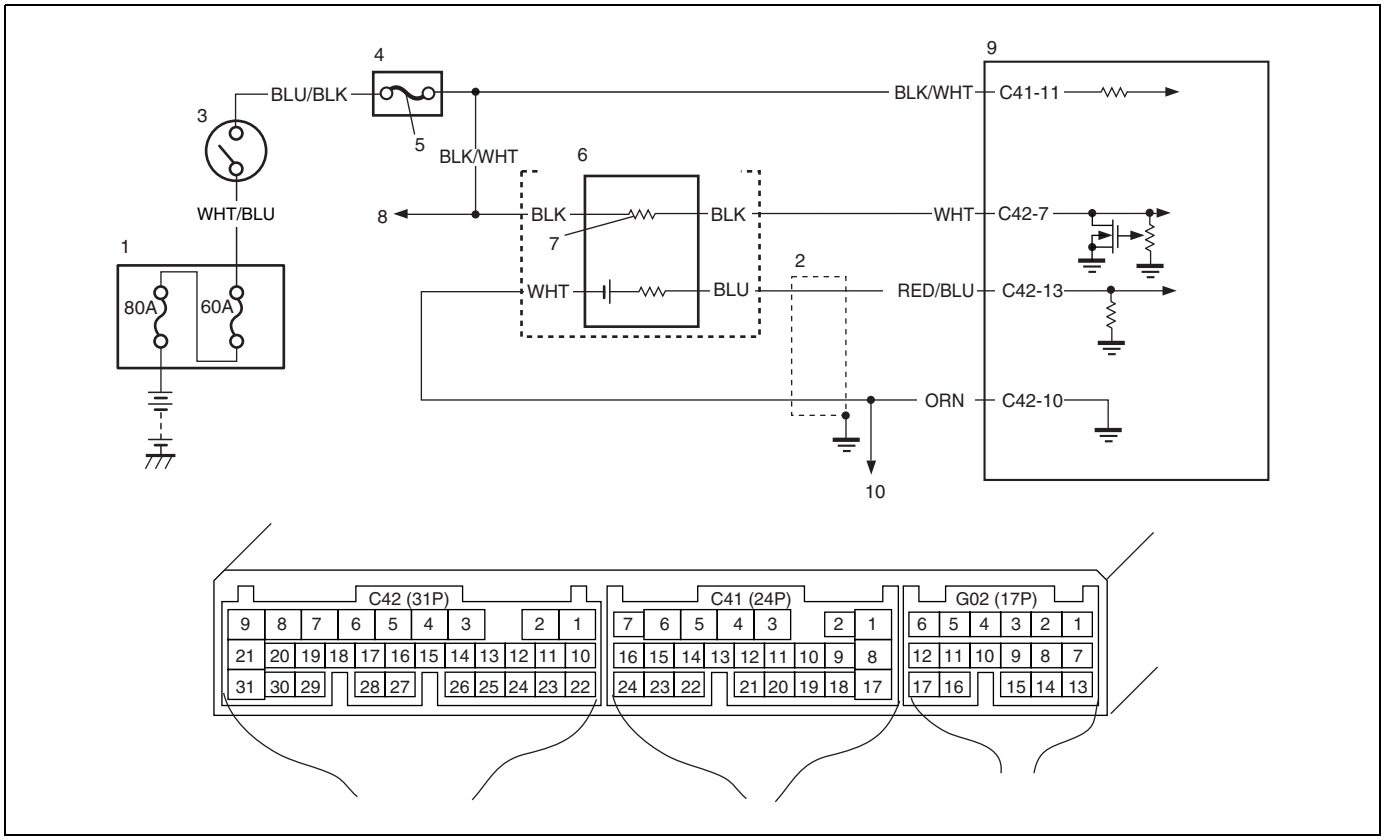
DTC P0135 (DTC No.14) Heated Oxygen Sensor (HO2S) Heater Circuit Malfunction (Sensor-1)

Wiring Diagram



1. Relay box	3. Ignition switch	5. "IG" fuse	7. Heater	9. ECM
2. Shield wire	4. Circuit fuse box	6. HO2S–1	8. To HO2S–2 heater	10. To other sensors

DTC Detecting Condition and Trouble Area

DTC Detecting Condition	Trouble Area
DTC will set when one of the following conditions is met. • Low voltage at terminal C42-7 when engine is running at high load. • High voltage at terminal C42-7 when engine is running under condition other than above. ✱2 driving cycle detection logic, Continuous monitoring.	• HO2S–1 heater circuit open or shorted to ground • ECM malfunction

DTC Confirmation Procedure

WARNING:
- **When performing a road test, select a place where there is no traffic or possibility of a traffic accident and be very careful during testing to avoid occurrence of an accident.**
- **Road test should be carried out with 2 persons, a driver and a tester.**

1) Turn ignition switch OFF.
2) Clear DTC with ignition switch ON, start engine and keep it at idle for 1 min.
3) Start vehicle and depress accelerator pedal fully for 5 sec. or longer.
4) Stop vehicle.
5) Check DTC in "DTC" mode and pending DTC in "ON BOARD TEST" or "PENDING DTC" mode.

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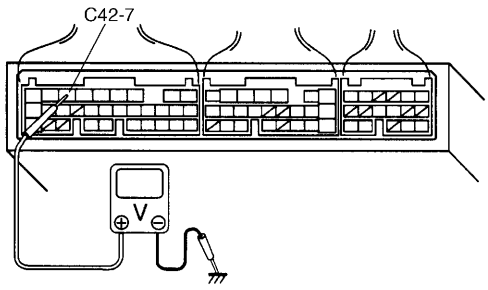
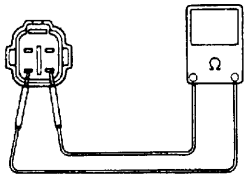
Troubleshooting

Step	Action	Yes	No
1	Was “Engine and Emission Control System Check” performed?	Go to Step 2.	Go to “Engine and Emission Control System Check”.
2	Check Heater for operation. 1) Check voltage at terminal C42-7. See Fig. 1. 2) Warm up engine to normal operating temperature. 3) Stop engine. 4) Turn ignition switch ON and Check voltage at terminal C42-7. See Fig. 1. Voltage should be over 10 V. 5) Start engine, run it at idle and check voltage at the same terminal. Voltage should be below 1.9 V. Are check results are specified?	Intermittent trouble Check for intermittent referring to “Intermittent and Poor Connection” in Section 0A.	Go to Step 3.
3	Check Heater of Sensor–1. 1) Disconnect HO2S–1 coupler with ignition switch OFF. 2) Check for proper connection to HO2S–1 at “BLK/WHT” and “RED/BLU” wire terminals. 3) If OK, then check heater resistance between “BLK” and “BLK” wire terminals of HO2S–1. See Fig. 2. Is it 5.0 – 6.4 Ω at 20°C, 68°F?	“RED/BLU” wire open or shorted to ground or poor connection at C42-7. If wire and connection are OK, substitute a known-good ECM and recheck.	Replace HO2S–1.

[A]



[B]



[A]: Fig. 1 for Step 2
[B]: Fig. 2 for Step 3

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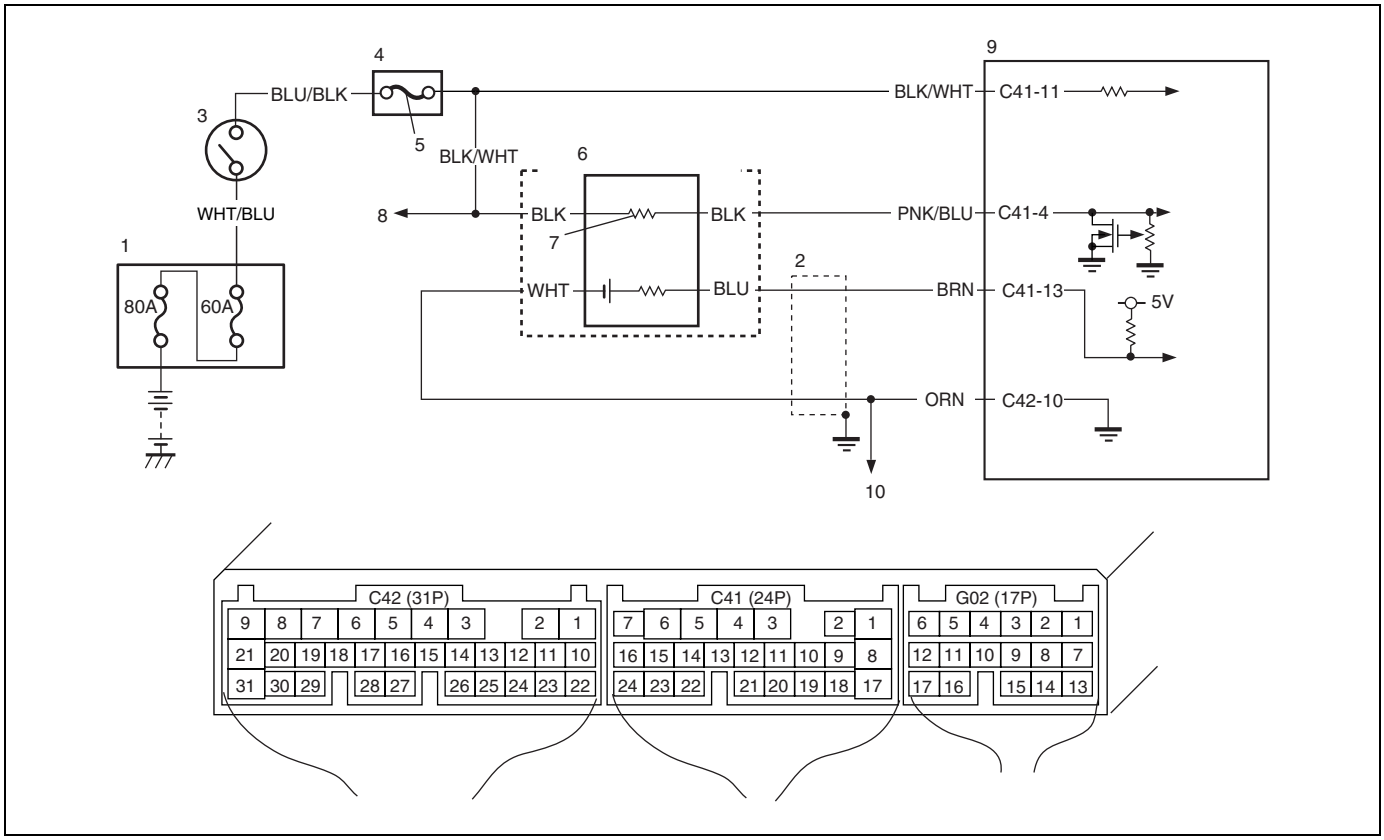
DTC P0136 Heated Oxygen Sensor (HO2S) Circuit Malfunction (Sensor-2)

Wiring Diagram



1. Relay box	3. Ignition switch	5. "IG" fuse	7. Heater	9. ECM
2. Shield wire	4. Circuit fuse box	6. HO2S–2	8. To HO2S–1 heater	10. To other sensors

DTC Detecting Condition and Trouble Area

DTC Detecting Condition	Trouble Area
DTC will set when one of the following conditions is detected. • Max. output voltage of HO2S–2 is lower than specified value or Min. output voltage is higher than specified value while vehicle driving. • Engine is warmed up and HO2S–2 voltage is 4.5 V or more. (circuit open) ✱2 driving cycle detection logic, monitoring once/1 driving.	• Exhaust gas leakage • "BRN", "YEL" or "ORN" circuit open or short • Heated oxygen sensor-2 malfunction • Fuel system malfunction

DTC Confirmation Procedure

WARNING:

- **When performing a road test, select a place where there is no traffic or possibility of a traffic accident and be very careful during testing to avoid occurrence of an accident.**
- **Road test should be carried out with 2 persons, a driver and a tester, on a level road.**

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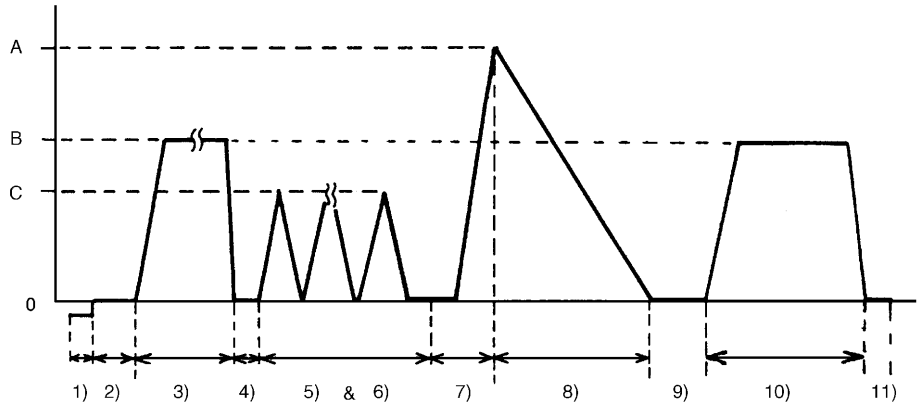
1) Turn ignition switch OFF.
   Clear DTC with ignition switch ON, check vehicle and environmental condition for:
   – Altitude (barometric pressure): 2400 m, 8000 ft or less (560 mmHg, 75 kPa or more)
   – Ambient temp.: –10°C, 14°F or higher
   – Intake air temp.: 70°C, 158°F or lower
   – No exhaust gas leakage and loose connection
2) Warm up engine to normal operating temperature.
3) Drive vehicle under usual driving condition for 5 min. and check HO2S–2 output voltage and “short term fuel trim” with “Data List” mode on scan tool, and write it down.
4) Stop vehicle (don’t turn ignition switch OFF).
5) Increase vehicle speed to higher than 20 mph, 32 km/h and then stop vehicle.
6) Repeat above steps 5) 4 times.
7) Increase vehicle speed to about 50 mph (80 km/h) in 3rd gear or 2 range.
8) Release accelerator pedal and with engine brake applied, keep vehicle coasting (fuel cut condition) for 10sec. or more.
9) Stop vehicle (don’t turn ignition switch OFF) and run engine at idle for 2 min.
   After this step 9), if “Oxygen Sensor Monitoring TEST COMPLETED” is displayed in “READINESS TESTS” mode and DTC is not displayed in “DTC” mode, confirmation test is completed.
   If “TEST NOT COMPLTD” is still being displayed, proceed to next step 10).
10) Drive vehicle under usual driving condition for 10 min. (or vehicle is at a stop and run engine at idle for 10 min. or longer)
11) Stop vehicle (don’t turn ignition switch OFF). Confirm test results according to “Test Result Confirmation Flow Table” in “DTC CONFIRMATION PROCEDURE” of DTC P0420.



A.	50 mph (80 km/h)
B.	*Usual diving
C.	Above 20 mph (32 km/h)
★Usual driving:	Driving at 30 – 40 mph, 50 – 60 km/h including short stop according to traffic signal. (under driving condition other than high-load, high-engine speed, rapid accelerating and decelerating)

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Troubleshooting

Step	Action	Yes	No
1	Was “Engine and Emission Control System Check” performed?	Go to Step 2.	Go to “Engine and Emission Control System Check”.
2	Check Exhaust System for leakage, loose connection and damage. Is it good condition?	Go to Step 3.	Repair or replace.
3	Check HO2S–2 and Its Circuit. Was HO2S–2 output voltage indicated on scan tool in step 3) of DTC confirmation test less than 1.275 V?	Go to Step 4.	“BRN”, “YEL” or “ORN” circuit short to power supply circuit or HO2S–2 malfunction.
4	Check Short Term Fuel Trim. Did short term fuel trim very within – 20 – + 20% range in step 3) of DTC confirmation test?	Check “BRN”, “YEL” or “ORN” wire for open and short, and connection for poor connection. If wire and connection are OK, replace HO2S–2.	Check fuel system. Go to DTC P0171/P0172 Diag. Flow Table.

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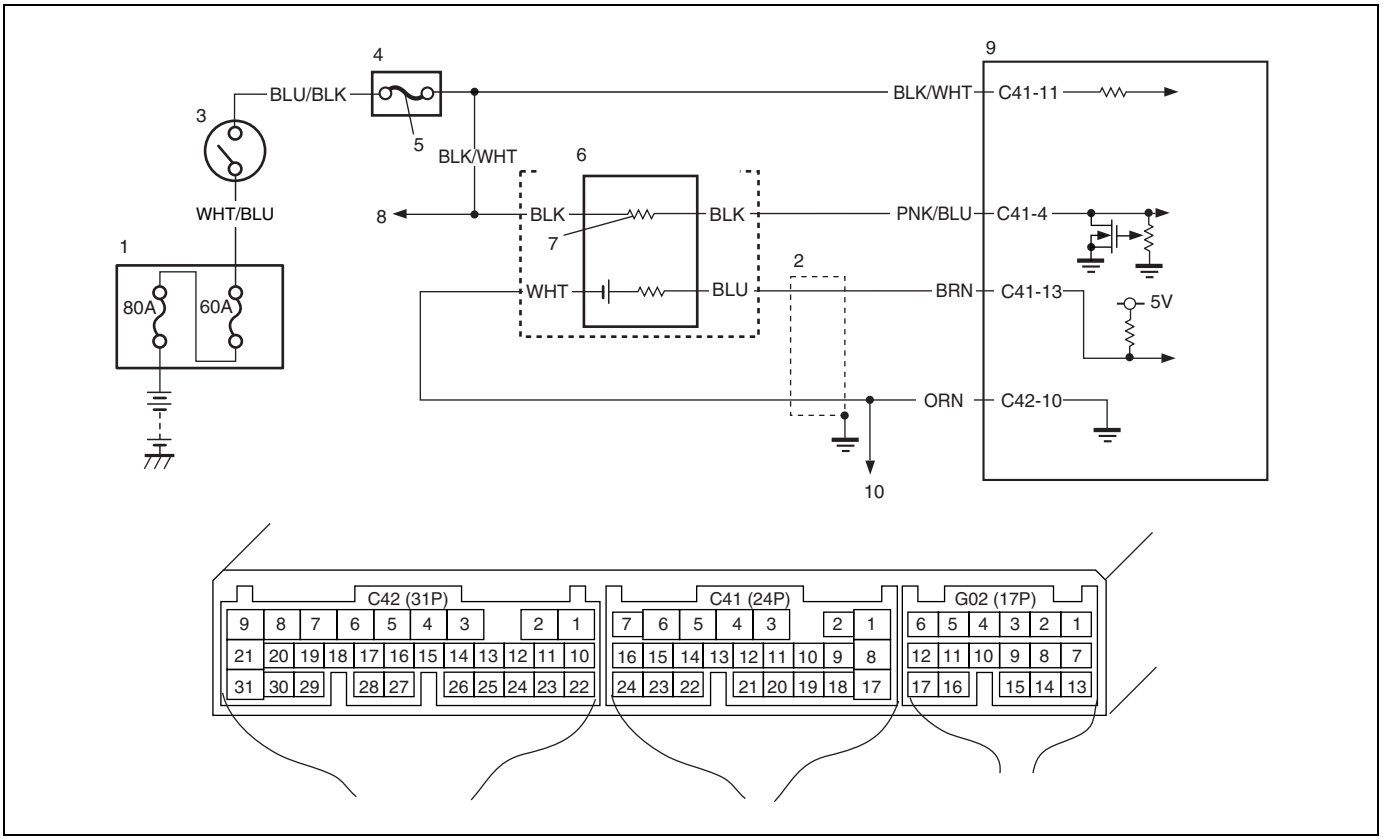
DTC P0141 Heated Oxygen Sensor (HO2S) Heater Circuit Malfunction (Sensor-2)

Wiring Diagram



1. Relay box	3. Ignition switch	5. "IG" fuse	7. Heater	9. ECM
2. Shield wire	4. Circuit fuse box	6. HO2S–2	8. To HO2S–1 heater	10. To other sensors

DTC Detecting Condition and Trouble Area

DTC Detecting Condition	Trouble Area
DTC will set when any one of the following conditions is met. • Low voltage at terminal C41-4 for specified time after engine start or while engine running at high load. • High voltage at terminal C41-4 while engine running under other than above condition. ✱2 driving cycle detection logic, continuous monitoring.	• HO2S–2 heater circuit open or shorted to ground • ECM malfunction

DTC Confirmation Procedure

1) Turn ignition switch OFF once and then ON.
2) Clear DTC, start engine and warm up engine to normal operating temperature.
3) Keep it at 2000 r/min for 2 min.
4) Check pending DTC in "ON BOARD TEST" or "PENDING DTC" mode and DTC in "DTC" mode.

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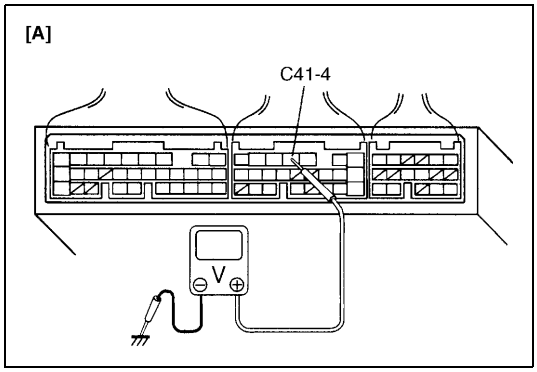
Troubleshooting

Step	Action	Yes	No
1	Was “Engine and Emission Control System Check” performed?	Go to Step 2.	Go to “Engine and Emission Control System Check”.
2	Check HO2S–2 Heater and Its Circuit. 1) Warm up engine to normal operating temperature. 2) Stop engine. 3) Turn ignition switch ON and check voltage at terminal C41-4 See Fig. 1. Voltage should be over 10 V. 4) Start engine, run it at idle and check voltage at the same terminal after 1 min. from engine start. Voltage should be below 1.9 V. Are check result as specified?	Intermittent trouble. Check for intermittent referring to “Intermittent and Poor Connection” in Section 0A.	Go to Step 3.
3	Check Heater of Sensor–2. 1) Disconnect HO2S–2 coupler with ignition switch OFF. 2) Check for proper connection to HO2S–2 at “BLK/WHT” and “PNK/BLU” wire terminals. 3) If OK, then check heater resistance. Is it 12.0 – 14.3 Ω at 20°C, 68°F?	“PNK/BLU” wire open or shorted to ground or poor connection at C41-4. If wire and connection are OK, substitute a known-good ECM and recheck.	Replace HO2S–2.



[A]: Fig. 1 for Step 2

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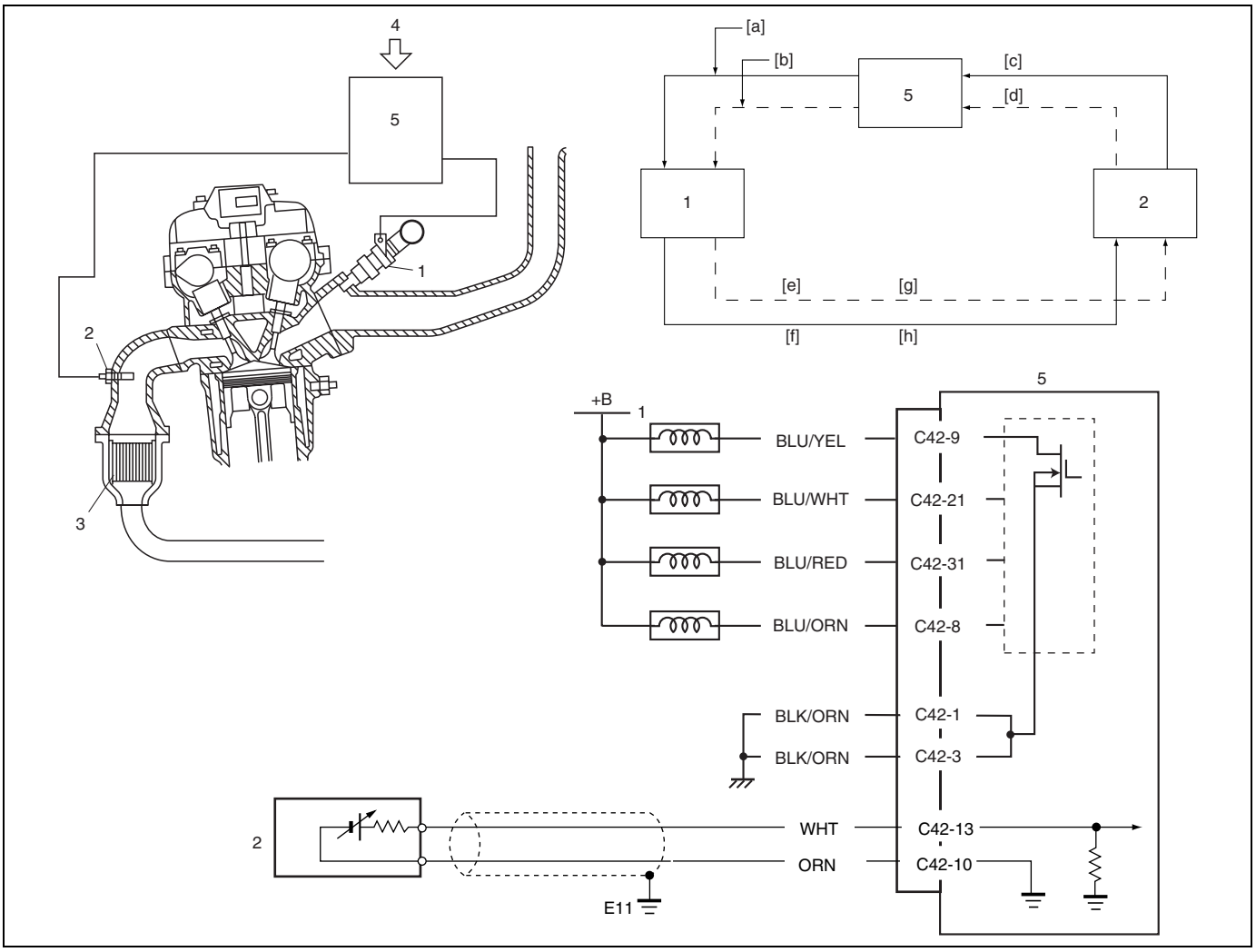
DTC P0171 Fuel System Too Lean
DTC P0172 Fuel System Too Rich

Wiring Diagram



1. Injector	[a]: Signal to decrease amount of fuel injection	[f]: A/F mixture becomes leaner
2. HO2S–1	[b]: Signal to increase amount of fuel injection	[g]: Oxygen concentration decreases
3. WU-TWC (Warm up-three way catalytic convector)	[c]: High voltage	[h]: Oxygen concentration increases
4. Sensed information	[d]: Low voltage	
5. ECM	[e]: A/F mixture becomes richer	

DTC Detecting Condition and Trouble Area

DTC Detecting Condition	Trouble Area
When one of the following conditions occurs while engine running under closed loop condition. • Air/fuel ratio too lean (Total fuel trim (short and long terms added) is more than 30%) • Air/fuel ratio too rich (Total fuel trim is less than – 30%) ✱2 driving cycle detection logic, continuous monitoring.	• Vacuum leaks (air drawn in). • Exhaust gas leakage. • Heated oxygen sensor-1 circuit malfunction. • Fuel pressure out of specification. • Fuel injector malfunction (clogged or leakage). • MAP sensor poor performance. • ECT sensor poor performance. • IAT sensor poor performance. • TP sensor poor performance. • EVAP control system malfunction. • PCV valve malfunction.

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DTC Confirmation Procedure

WARNING:
- **When performing a road test, select a place where there is no traffic or possibility of a traffic accident and be very careful during testing to avoid occurrence of an accident.**
- **Road test should be carried out with 2 persons, a driver and a tester, on a level road.**

1) Turn ignition switch OFF.
2) Clear DTC with ignition switch ON.
3) Check vehicle and environmental condition for:
   – Altitude (barometric pressure): 2400 m, 8000 ft or less (560 mmHg, 75 kPa or more)
   – Ambient temp.: –10°C, 14°F or higher
   – Intake air temp.: 70°C, 158°F or lower
4) Start engine and drive vehicle under usual driving condition (described in DTC confirmation procedure of DTC P0136) for 5 min. or longer and until engine is warmed up to normal operating temperature.
5) Keep vehicle speed at 30 – 40 mph, 50 – 60 km/h in 5th gear or “D” range for 5 min. or more.
6) Stop vehicle (do not turn ignition switch OFF).
7) Check pending DTC in “ON BOARD TEST” or “PENDING DTC” mode and DTC in “DTC” mode.

Troubleshooting

Step	Action	Yes	No
1	Was “Engine and Emission Control System Check” performed?	Go to Step 2.	Go to “Engine and Emission Control System Check”.
2	Is there DTC(s) other than fuel system (DTC P0171/P0172)?	Go to applicable DTC Diag. Flow Table.	Go to Step 3.
3	Check HO2S–1 Output Voltage. 1) Connect scan tool to DLC with ignition switch OFF. 2) Warm up engine to normal operating temperature and keep it at 2000 r/min. for 60 sec. 3) Repeat racing engine (Repeat depressing accelerator pedal 5 to 6 times continuously and take foot off from pedal to enrich and enlean A/F mixture). See Fig. 1. Does HO2S–1 output voltage deflect between below 0.3 V and over 0.6 V repeatedly?	Go to Step 4.	Go to DTC P0130 Diag. Flow Table (HO2S–1 circuit check).
4	Check Fuel Pressure (Refer to section 6E2 for details). 1) Release fuel pressure from fuel feed line. 2) Install fuel pressure gauge. 3) Check fuel pressure. See Fig. 2. With fuel pump operating and engine at stop: 270 – 310 kPa, 2.7 – 3.1 kg/cm^2, 38.4 – 44.0 psi. At specified idle speed: 270 – 310 kPa, 2.7 – 3.1 kg/cm^2, 38.4 – 44.0 psi. Is measured value as specified?	Go to Step 5.	Go to Diag. Flow Table B-3 Fuel Pressure Check.

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Step	Action	Yes	No
5	Check Fuel Injectors and Circuit. 1) Using sound scope (1) or such, check operating sound of each injector (2) when engine is running. Cycle of operating sound should vary according to engine speed. See Fig. 3. If no sound or an unusual sound is heard, check injector circuit (wire or coupler) or injector. 2) Turn ignition switch OFF and disconnect a fuel injector connector. 3) Check for proper connection to fuel injector at each terminal. See Fig. 4. 4) If OK, then check injector resistance. Injector Resistance: 11.3 – 13.8 ohm at 20°C (68°F) 5) Carry out steps 1) and 3) on each injector. 6) Check each injector for injected fuel volume (1) referring to “Fuel injector inspection” in Section 6E2. See Fig. 5. Injected Fuel Volume: 43 – 47 cc/15 sec 1.45/1.51 – 1.58/1.65 US/Imp.oz/15 sec) 7) Check each injector for fuel leakage after injector closed. Fuel Leakage: Less than 1 drop/min. Is check result in step 1) and 3) to 7) satisfactory?	Go to Step 6.	Check injector circuit or replace fuel injector(s).
6	Check EVAP Canister Purge Valve. 1) Disconnect purge hose from EVAP canister purge valve. 2) Place finger against the end of EVAP canister purge valve. 3) Check that vacuum is not felt there when engine is cool and running at idle. See Fig. 6. Is vacuum felt?	Check EVAP canister purge valve and its circuit referring to “Evaporative emission control system inspection” in Section 6E2.	Go to Step 7.
7	Check Intake manifold absolute pressure sensor for performance (See DTC P0105 (No.11) Diag. Flow Table). Is it in good condition?	Go to Step 8.	Repair or replace.
8	Check Engine Coolant Temp. Sensor for performance referring to “Engine coolant temperature sensor (ECT sensor) inspection” in Section 6E2. Is it in good condition?	Go to Step 9.	Replace engine coolant temp. sensor.
9	Check Intake Air Temp. Sensor for performance referring to “Intake air temperature sensor (IAT sensor) inspection” in Section 6E2. Is it in good condition?	Go to Step 10.	Replace intake air temp. sensor.

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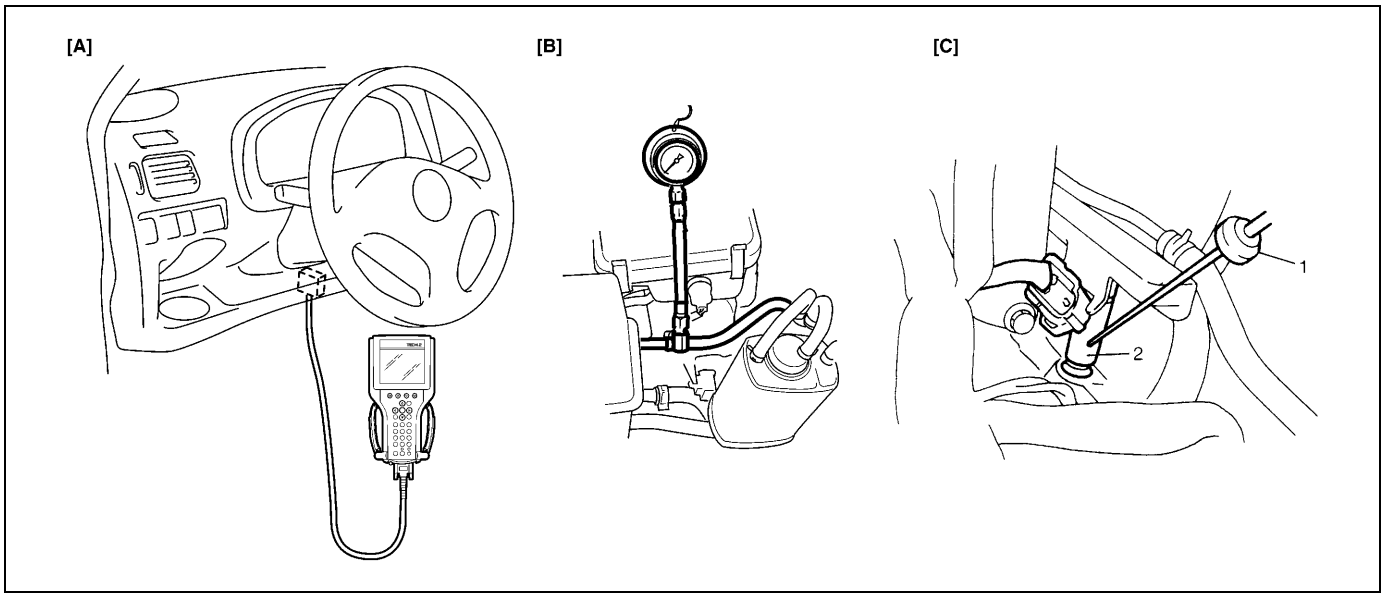
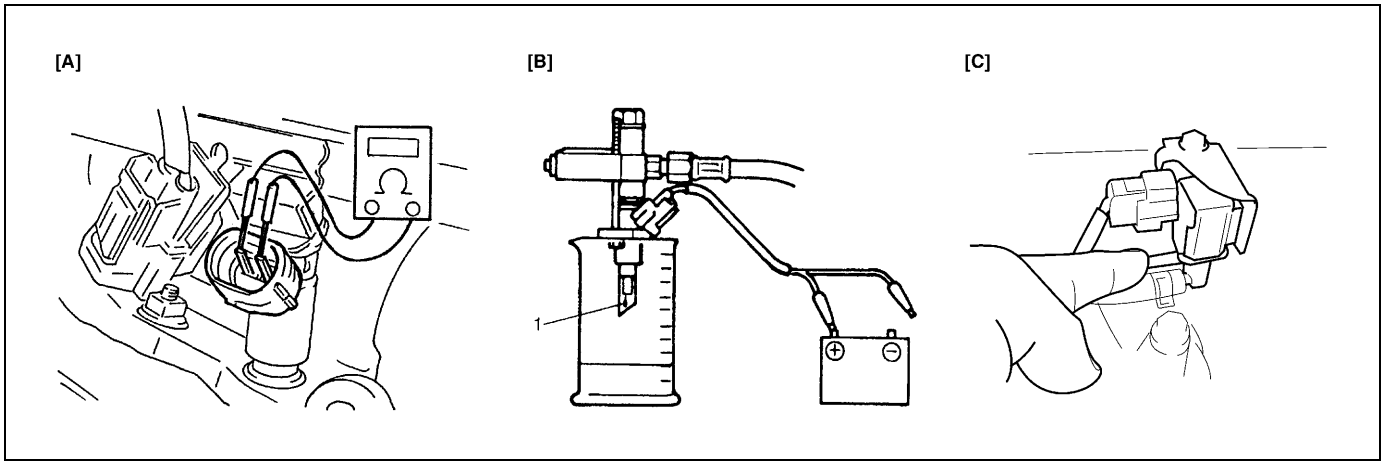
Step	Action	Yes	No
10	Check Throttle Position Sensor for performance (See Step 4 of DTC P0121 Diag. Flow Table). Is it in good condition?	Go to Step 11.	Replace throttle position sensor.
11	Check PCV Valve for valve clogging referring to "Evaporative emission control system inspection" in Section 6E2. Is it good condition?	Substitute a known-good ECM and recheck.	Replace PCV valve.



[A]: Fig. 1 for Step 3
[B]: Fig. 2 for Step 4
[C]: Fig. 3 for Step 5



[A]: Fig. 4 for Step 5
[B]: Fig. 5 for Step 5
[C]: Fig. 6 for Step 6

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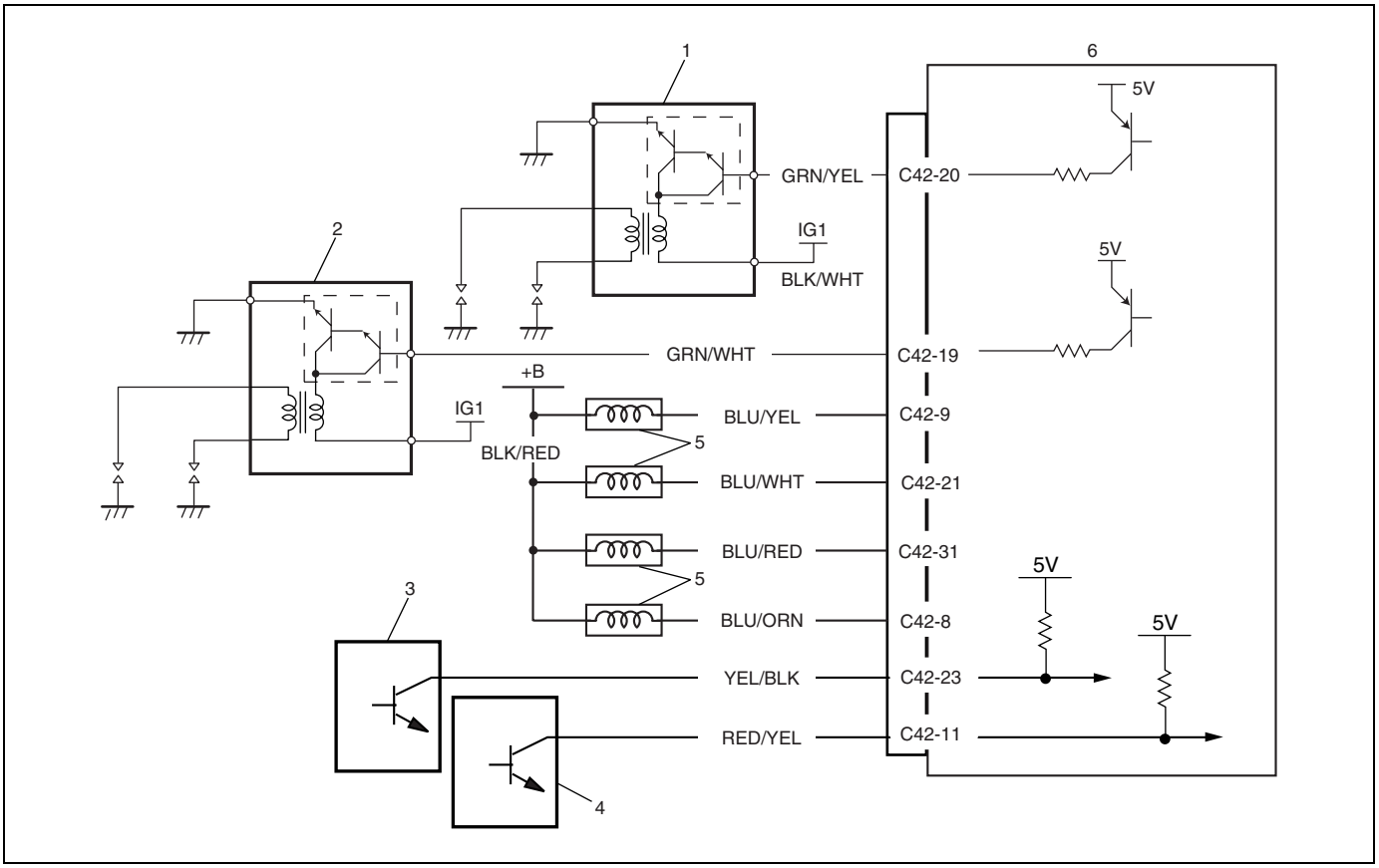
DTC P0300 Random Misfire Detected (Misfire Detected at 2 or More Cylinders)
DTC P0301 Cylinder 1 Misfire Detected
DTC P0302 Cylinder 2 Misfire Detected
DTC P0303 Cylinder 3 Misfire Detected
DTC P0304 Cylinder 4 Misfire Detected

Wiring Diagram



1. Ignition coil No. 1	3. CKP sensor	5. Fuel injector
2. Ignition coil No. 2	4. CMP sensor	6. ECM

Circuit Description

ECM monitors crankshaft revolution speed and engine speed via the crankshaft position sensor and cylinder No. via the camshaft position sensor. Then it calculates the change in the crankshaft revolution speed and from how many times such change occurred in every 200 or 1000 engine revolutions, it detects occurrence of misfire. When ECM detects a misfire (misfire rate per 200 revolutions) which can cause overheat and damage to the three way catalytic converter, it makes the malfunction indicator lamp (MIL) flash as long as misfire occurs at that rate.

After that, however, when the misfire rate drops, MIL remains ON until it has been judged as normal 3 times under the same driving conditions.

Also, when ECM detects a misfire (misfire rate per 1000 revolutions) which will not cause damage to three way catalytic converter but can cause exhaust emission to be deteriorated, it makes MIL light according to the 2 driving cycle detection logic.

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DTC Detecting Condition and Trouble Area

DTC Detecting Condition	Trouble Area
• Engine under other than high revolution condition • Not on rough road • Engine speed changing rate (Below specified value) • Manifold absolute pressure changing rate (Below specified value) • Throttle opening changing rate (Below specified value) • Misfire rate per 200 or 1000 engine revolutions (how much and how often crankshaft revolution speed changes) is higher than specified value	• Engine overheating • Vacuum leaks (air inhaling) from air intake system • Ignition system malfunction (spark plug(s), high-tension cord(s), ignition coil assembly) • Fuel pressure out of specification • Fuel injector malfunction (clogged or leakage) • Engine compression out of specification • Valve lash (clearance) out of specification • Manifold absolute pressure sensor malfunction • Engine coolant temp. sensor malfunction • PCV valve malfunction • EVAP control system malfunction • EGR system malfunction

DTC Confirmation Procedure

NOTE:

Among different types of random misfire, if misfire occurs at cylinders 1 and 4 or cylinders 3 and 2 simultaneously, it may not possible to reconfirm DTC by using the following DTC confirmation procedure. When diagnosing the trouble of DTC P0300 (Random misfire detected) of the engine which is apparently misfiring, even if DTC P0300 cannot be reconfirmed by using the following DTC confirmation procedure, proceed to the following Diag. Flow Table.

WARNING:

- **When performing a road test, select a place where there is no traffic or possibility of a traffic accident and be very careful during testing to avoid occurrence of an accident.**
- **Road test should be carried out with 2 persons, a driver and a tester.**

1) Turn ignition switch OFF.
2) Clear DTC with ignition switch ON.
3) Check vehicle and environmental condition for:
   – Altitude (barometric pressure): 2400 m, 8000 ft or less (560 mmHg, 75 kPa or more)
   – Ambient temp.: –10°C, 14°F or higher
   – Intake air temp.: 70°C, 158°F or lower
   – Engine coolant temp.: – 10 – 110°C, 14 – 230°F
4) Start engine and keep it at idle for 2 min. or more.
5) Check DTC in “DTC” mode and pending DTC in “ON BOARD TEST” or “PENDING DTC” mode.
6) If DTC is not detected at idle, consult usual driving based on information obtained in “Customer complaint analysis” and “Freeze frame data check”.

Troubleshooting

CAUTION:

For iridium spark plugs, do not adjust air gap or clean.

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Step	Action	Yes	No
1	Was “Engine and Emission Control System Check” performed?	Go to Step 2.	Go to “Engine and Emission Control System Check”.
2	Is there DTC other than Fuel system (DTC P0171/ P0172) and misfire (DTC P0300-P0304)?	Go to applicable DTC Diag. Flow Table.	Go to Step 3.
3	Check Ignition System. 1) Remove spark plugs and check them for; • Air gap: 1.0 – 1.1 mm (0.040 – 0.043 in.) See Fig. 1. • Carbon deposits/Insulator damage/Plug type If abnormality is found, adjust, clean or replace. 2) Disconnect all injector connectors. 3) Connect spark plugs to high tension cords and then ground spark plugs. 4) Crank engine and check that each spark plug sparks. Are above check results satisfactory?	Go to Step 4.	Check ignition system parts (Refer to Section 6F1)
4	Check Fuel Pressure (Refer to Section 6E2 for details). 1) Release fuel pressure from fuel feed line. 2) Install fuel pressure gauge. See Fig. 2. 3) Check fuel pressure. With fuel pump operating and engine at stop: 270 – 310 kPa, 2.7 – 3.1 kg/cm^2, 38.4 – 44.0 psi. At specified idle speed: 270 – 310 kPa, 2.7 – 3.1 kg/cm^2, 38.4 – 44.0 psi. Is measured value as specified?	Go to Step 5.	Go to Diag. Flow Table B-3 fuel pressure check.
5	Check Fuel Injectors and Circuit. 1) Using sound scope (3) or such, check operating sound of each injector (4) when engine is running. Cycle of operating sound should very according to engine speed. See Fig 3. If no sound or an unusual sound is heard, check injector circuit (wire or connector) or injector. 2) Turn ignition switch OFF and disconnect a fuel injector connector. 3) Check for proper connection to fuel injector at each terminal. See Fig. 4. 4) If OK, then check injector resistance. Injector Resistance: 11.3 – 13.8 ohm at 20°C (68°F) 5) Carry out steps 1) and 3) on each injector. 6) Check each injector for injected fuel volume referring to “Fuel injector inspection” in Section 6E2. See Fig. 5. Injected Fuel Volume: 43 – 47 cc/15 sec (1.45/1.51 – 1.58/1.65 US/Imp. oz/15 sec) 7) Check each injector for fuel leakage after injector closed. Fuel Leakage: Less than 1 drop/min. Is check result in step 1) and 3) to 7) satisfactory?	Go to Step 6.	Check injector circuit or replace fuel injector(s).

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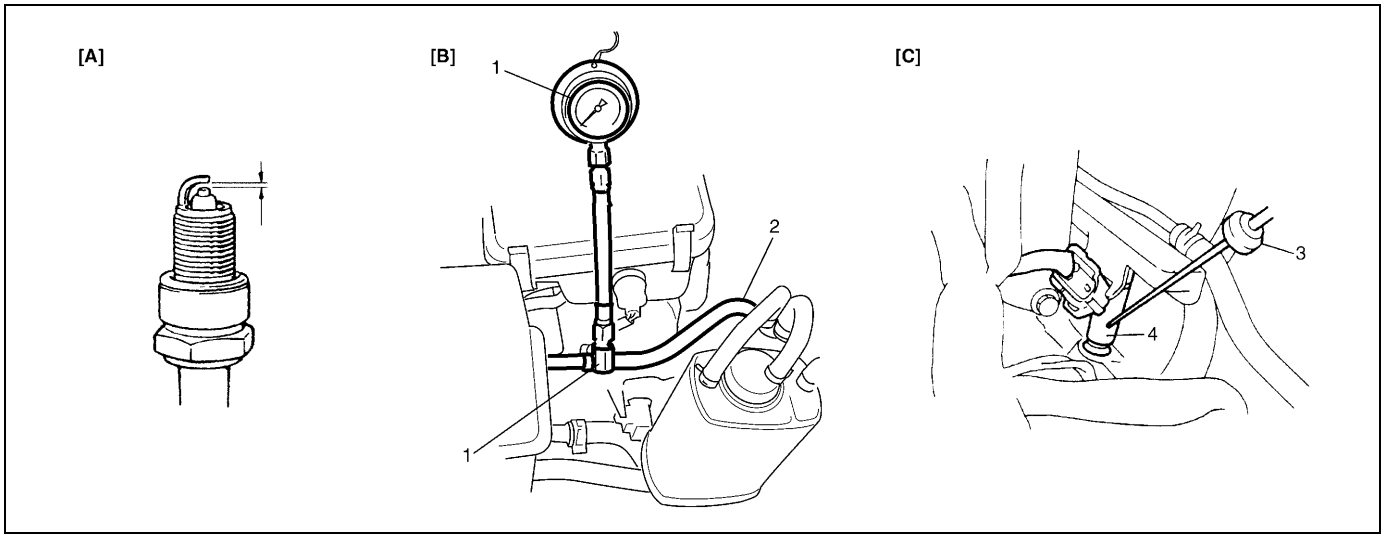
Step	Action	Yes	No
6	Check PCV Valve for clogging referring to Evaporative emission control system inspection" in Section 6E2. Is it in good condition?	Go to Step 7.	Replace PCV valve.
7	Check EVAP Canister Purge Valve for Closing. 1) Disconnect purge hose from EVAP canister purge valve. 2) Place finger against the end of EVAP canister purge valve. 3) Check that vacuum is not felt there, when engine is cool and running at idle. See Fig. 6. Is vacuum felt?	Check EVAP canister purge valve and its circuit referring to "Evaporative emission control system inspection" in 6E2.	Go to Step 8.
8	Check MAP Sensor for performance (Refer to DTC P0105 Diag. Flow Table). Is it in good condition?	Go to Step 9.	Repair or replace.
9	Check ECT Sensor for performance referring to "Engine coolant temperature sensor (ECT sensor) inspection" in Section 6E2. Is it in good condition?	Go to Step 10.	Replace engine coolant temp. sensor.
10	Check Parts or System which can cause engine rough idle or poor performance. • Engine compression referring to "COMPRESSION CHECK" in Section 6A1. • Valve lash referring to "VALVE LASH (CLERANCE)" in Section 6A1. • Valve timing (Timing chain installation.) referring to "TIMING CHAIN AND CHAIN TENSIONER" in Section 6A1. Are they in good condition?	Check wire harness and connection of ECM ground, ignition system and fuel injector for intermittent open and short.	Repair or replace.



[A]: Fig. 1 for Step 3	1. Fuel pressure gauge & 3 way joint
[B]: Fig. 2 for Step 4	2. Fuel feed hose
[C]: Fig. 3 for Step 5	

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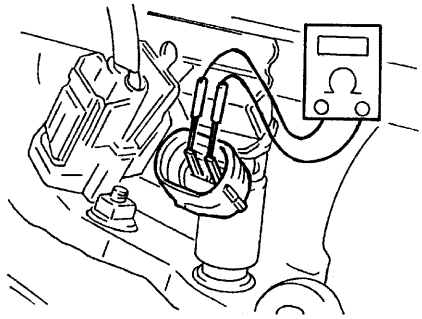
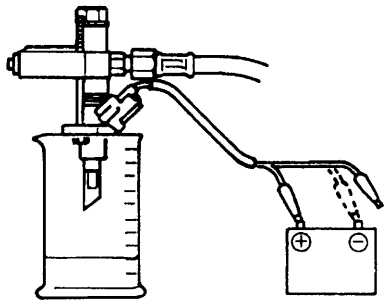
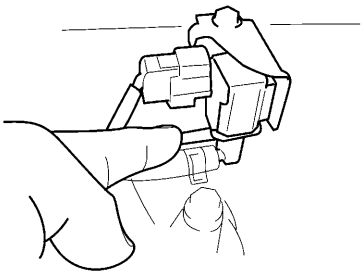
[A]



[B]



[C]



[A]: Fig. 4 for Step 5
[B]: Fig. 5 for Step 5
[C]: Fig. 6 for Step 7

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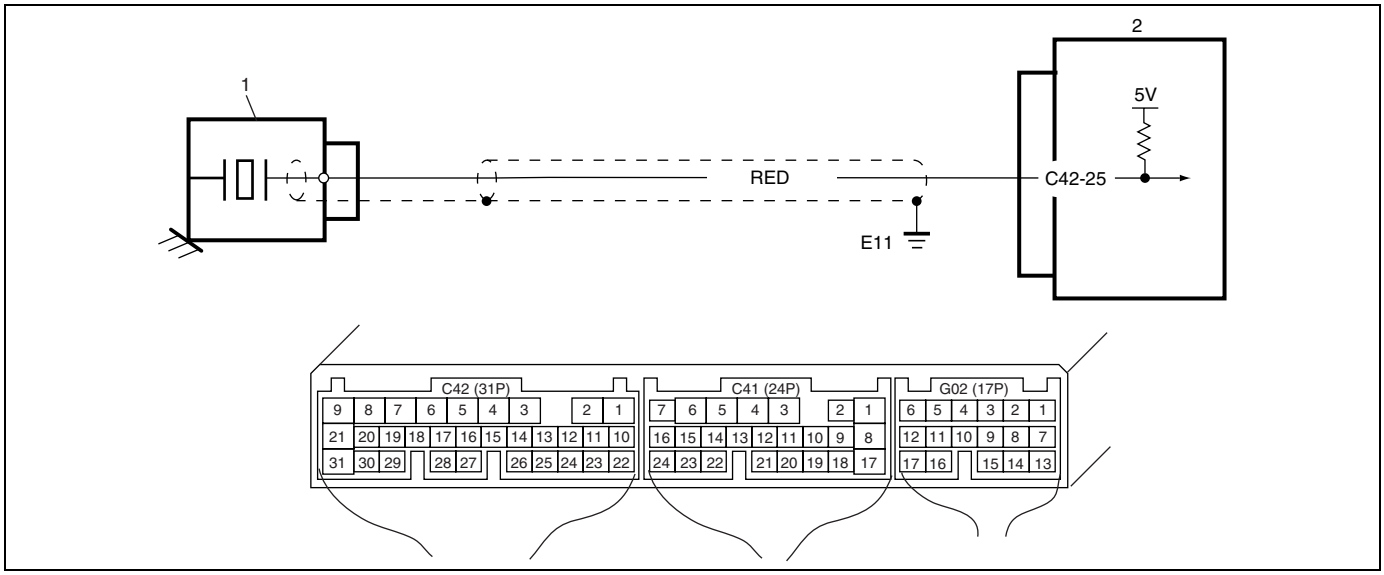
DTC P0325 (DTC No.17) Knock Sensor Circuit Malfunction

Wiring Diagram



1. KNK sensor	2. ECM

DTC Detecting Condition and Trouble Area

DTC Detecting Condition	Trouble Area
• Knock sensor voltage is 3.91 V or more or • Knock sensor voltage is 1.23 V or less	• "RED" circuit open or shorted to ground • Knock sensor malfunction • ECM malfunction

DTC Confirmation Procedure

1) Clear DTC, start engine and keep it at idle for 1 min.
2) Select "DTC" mode on scan tool and check DTC.

Troubleshooting

Step	Action	Yes	No
1	Was "Engine and Emission Control System Check" performed?	Go to Step 2.	Go to "Engine and Emission Control System Check".
2	Check Knock Sensor Signal. 1) With engine running, check voltage from C42-25 terminal of ECM connector to body ground. See Fig. 1. Is voltage about 1.23 – 3.91 V?	Knock sensor and its circuit are in good condition. Intermittent trouble or faulty ECM. Recheck, referring to Intermittent Trouble in Section 0A.	Go to Step 3.
3	Check Knock Sensor Output. 1) Stop engine. 2) With ignition switch at OFF position, disconnect knock sensor connector. 3) With ignition switch at ON position, check voltage from "RED" terminal of knock sensor connector to body ground. See Fig. 2. Is it 4 – 5 V?	Faulty knock sensor. Substitute a known-good knock sensor and recheck.	"RED" wire open, shorted to ground circuit or poor 42-25 connection. If wire and connection are OK, substitute a known-good ECM and recheck.

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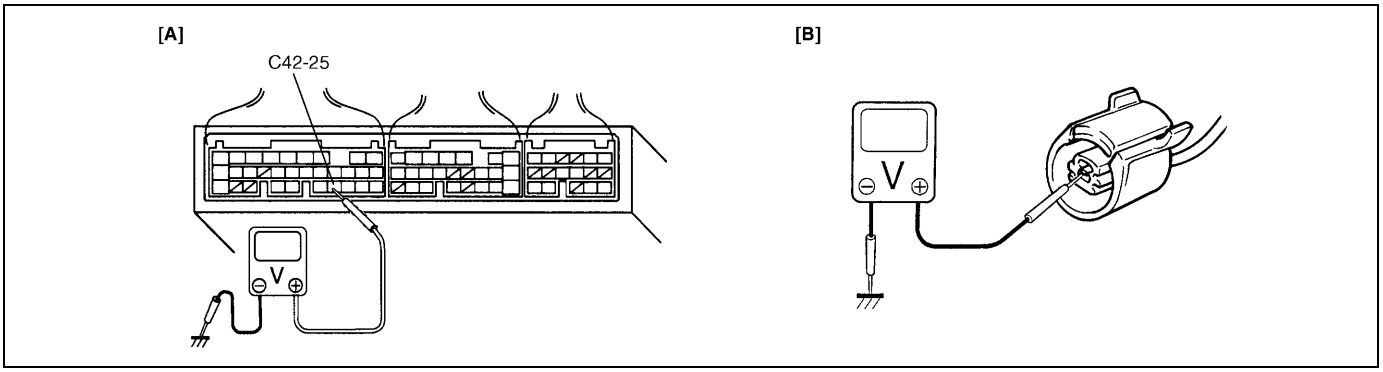

[A]: Fig. 1 for Step 2
[B]: Fig. 2 for Step 2

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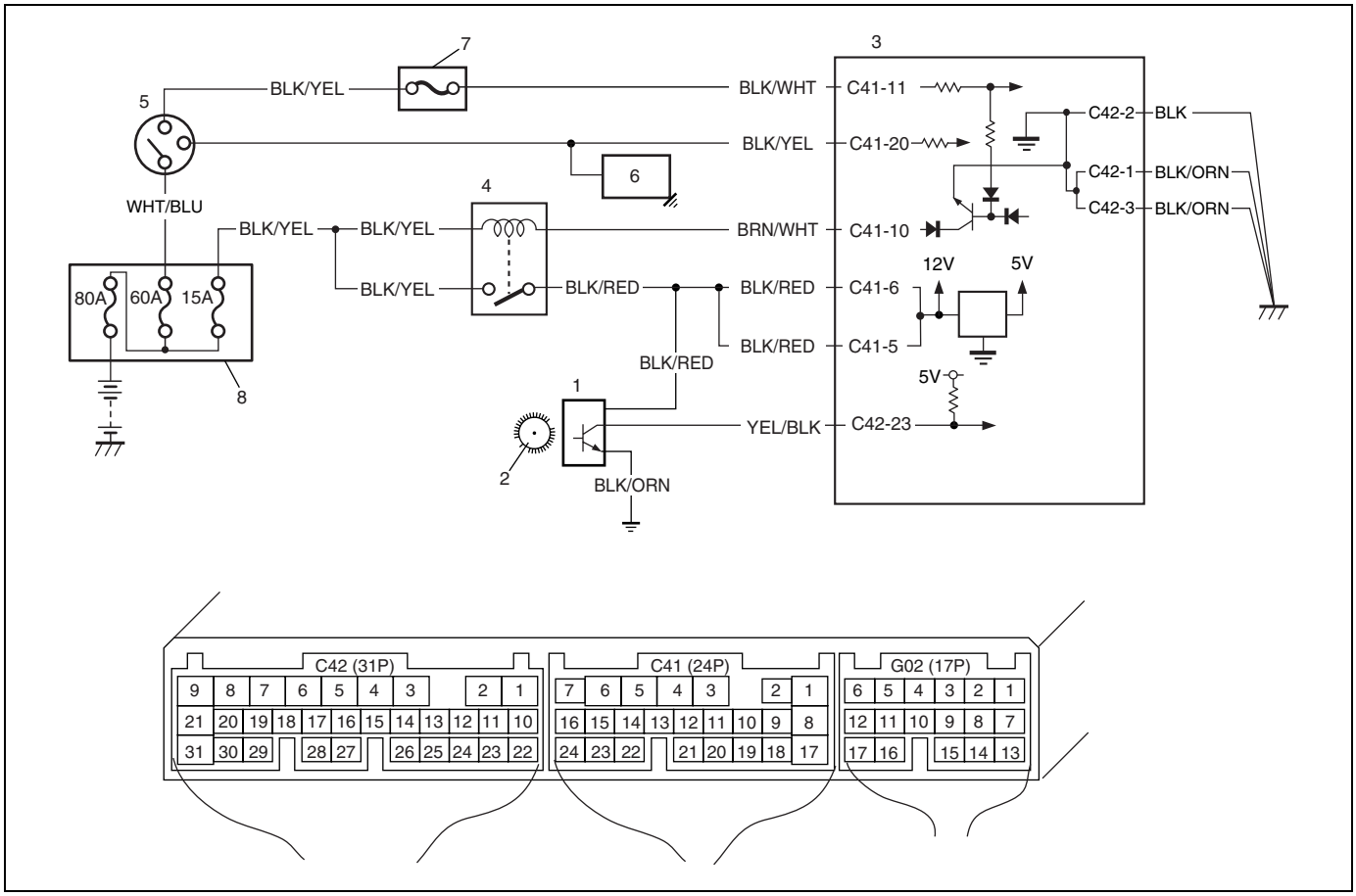
DTC P0335 (DTC No.23) Crankshaft Position (CKP) Sensor Circuit Malfunction

Wiring Diagram



1. CKP sensor	3. ECM	5. Ignition switch	7. "IG" fuse
2. Sensor rotor	4. Main relay	6. Starting motor	8. Main fuse box

DTC Detecting Condition and Trouble Area

DTC Detecting Condition	Trouble Area
• No CKP sensor signal for 2 seconds at engine cranking.	• CKP sensor circuit open or short. • Crankshaft timing belt pulley teeth damaged. • CKP sensor malfunction, foreign material being attached or improper installation. • ECM malfunction.

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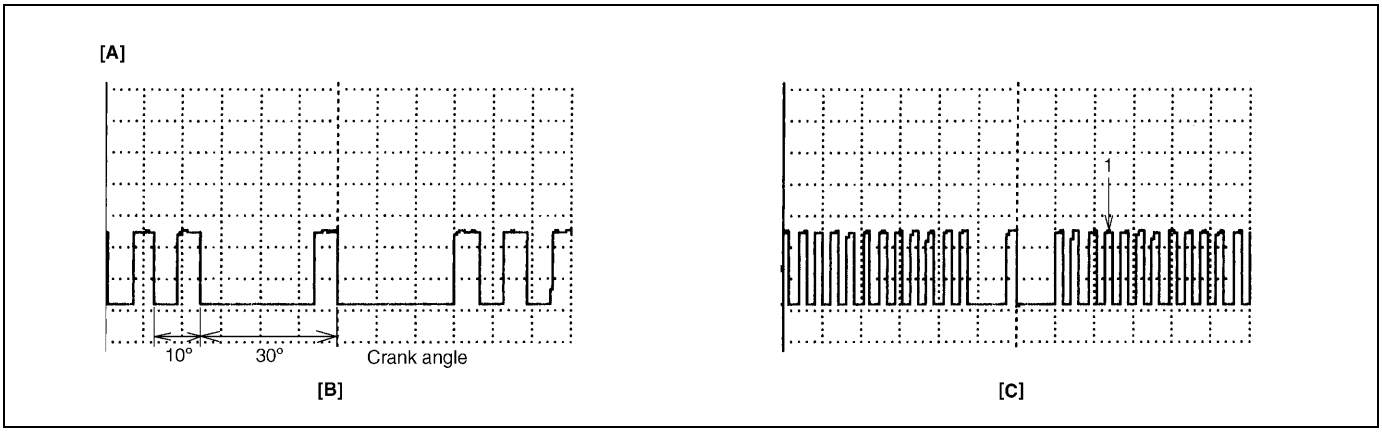
Reference

Connect oscilloscope between terminals C42-23 of ECM connector connected to ECM and ground and check CKP sensor signal.



1. BTDC 5° (Crank angle)	[B]: Waveforms at specified idle speed
[A]: Oscilloscope Waveforms	[C]: Waveforms at 2000 r/min

DTC Confirmation Procedure

1) Clear DTC and crank engine for 2 sec.
2) Select “DTC” mode on scan tool and check DTC.

Troubleshooting

Step	Action	Yes	No
1	Was “Engine and Emission Control System Check” performed?	Go to Step 2.	Go to “Engine and Emission Control System Check”.
2	Check CKP Sensor and Connector for proper installation. Is CKP sensor installed properly and connector connected securely?	Go to Step 3.	Correct.
3	Check Wire Harness and Connection. 1) Disconnect connector from CKP sensor. 2) Check for proper connection to CKP sensor at each terminal. 3) If OK, turn ignition switch ON and check for voltage at each terminal of sensor connector disconnected. See Fig. 1. Terminal “B+”: 10 – 14 V Terminal “Vout”: 4 – 5 V Terminal “GND”: – 0 V Is check result satisfactory?	Go to Step 5.	Go to Step 4.
4	Was terminal “Vout” voltage out of specification in Step 3 check?	“YEL/BLK” wire open, short or poor connection. If wire and connection are OK, substitute a known-good ECM and recheck.	“BLK/RED” or “BLK/ORN” wire open, short or poor connection.

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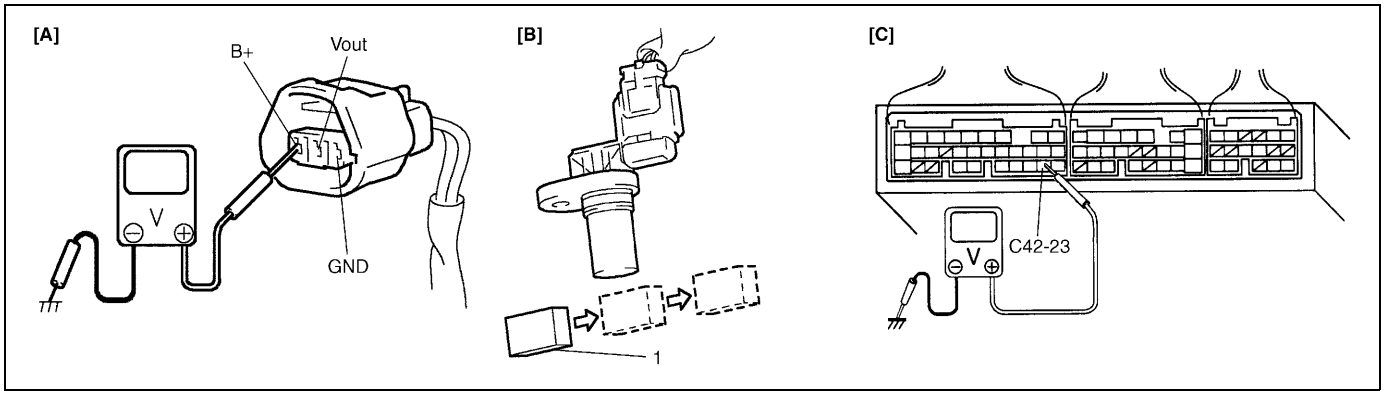
Step	Action	Yes	No
5	Check Ground Circuit for open. 1) Turn ignition switch OFF. 2) Check for continuity between “GND” terminal of CKP sensor connector and engine ground. Is continuity indicated?	Go to Step 6.	“BLK/ORN” wire open or poor ground connection.
6	Check Engine Start Signal. 1) Check voltage between “C41-20” wire terminal of ECM connector and engine ground with engine cranking. Does it voltage more than 6 V?	Go to Step 7.	“BLK/YEL” wire circuit open, high resistance or shorted to ground. If wire are OK, check starting motor referring to “Performance Test” in Section 6G.
7	Check CKP Sensor for operation. 1) Remove CKP sensor from sensor case. 2) Remove metal particles on end face of CKP sensor, if any. 3) Connect each connector to ECM and CKP sensor. 4) Turn ignition switch ON. 5) Check for voltage at terminal C42-23 of connector connected to ECM by passing magnetic substance (iron) while keeping approximately 1 mm (0.03 in.) gap with respect to end face of CKP sensor. See Fig. 2 and 3. Does voltage vary from low (0 –1 V) to high (4 – 5 V) or from high to low?	Go to Step 8.	Replace CKP sensor.
8	Check Signal Rotor for the following. See Fig. 4. • Damage • No foreign material attached Is it in good condition?	Substitute a known-good ECM and recheck.	Clean rotor teeth or replace CMP sensor.



[A]: Fig. 1 for Step 3	[C]: Fig. 3 for Step 6
[B]: Fig. 2 for Step 6	1. Magnetic substance (iron)

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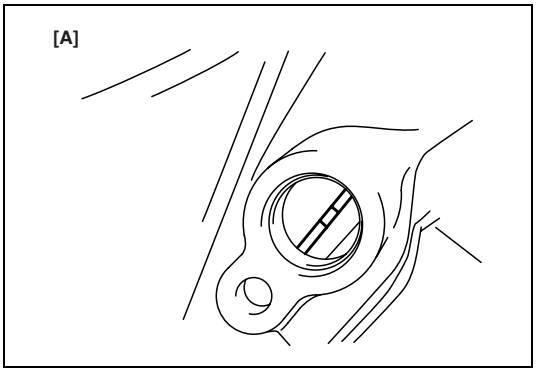

[A]: Fig. 4 for Step 7

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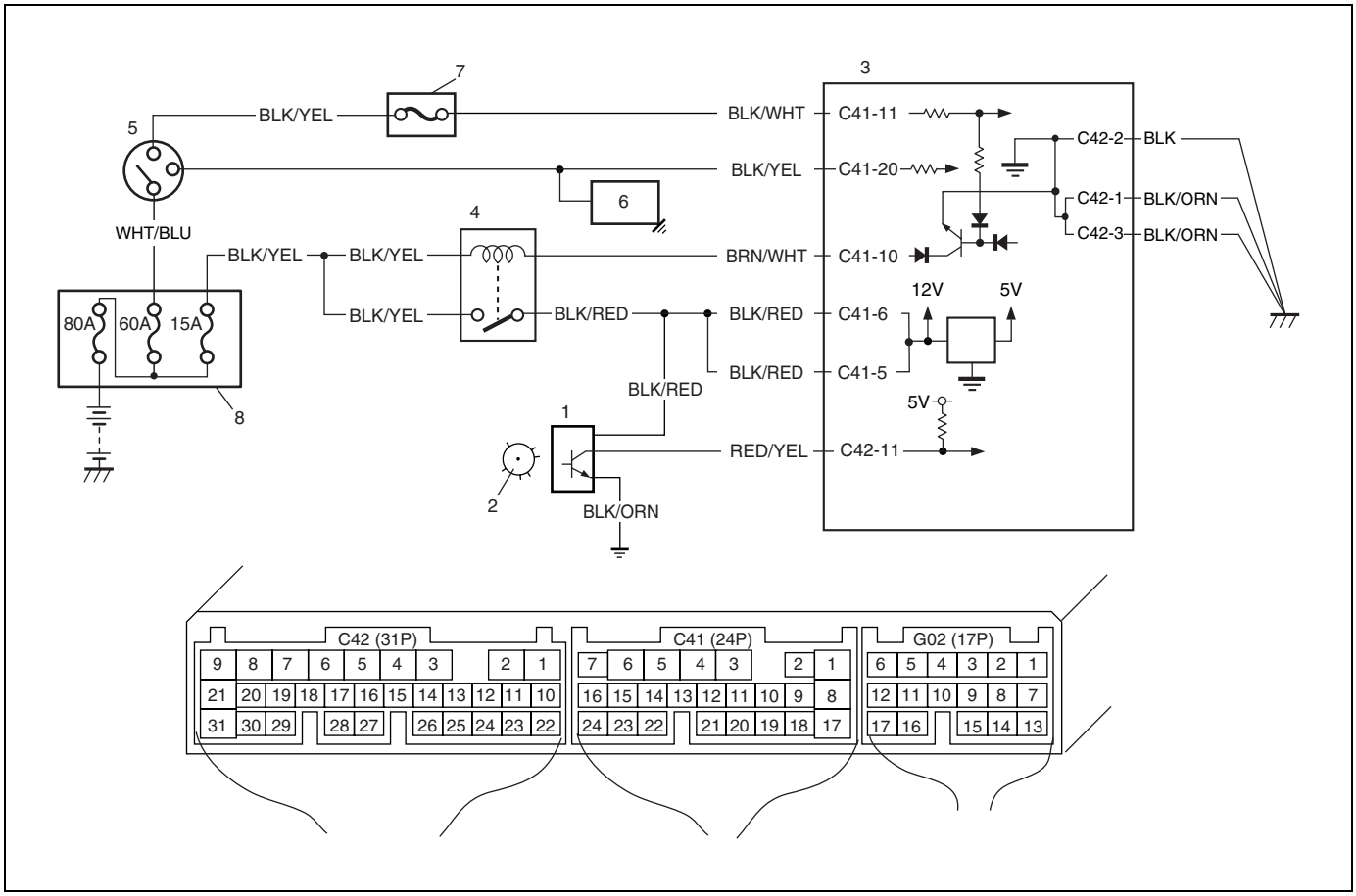
DTC P0340 (DTC No.15) Camshaft Position (CMP) Sensor Circuit Malfunction

Wiring Diagram



1. CMP sensor	3. ECM	5. Ignition switch	7. "IG" fuse
2. Sensor rotor	4. Main relay	6. Starting motor	8. Main fuse box

DTC Detecting Condition and Trouble Area

DTC Detecting Condition	Trouble Area
• No CMP sensor signal during engine running (CKP sensor signal is inputted). • Incongruous pulse signal timing between CMP sensor and CKP sensor • When crank is turned to specified angle, counts of CMP sensor signal pulse is more or less than specified.	• CMP sensor circuit open or short. • Signal rotor teeth damaged. • CMP sensor malfunction, foreign material being attached or improper installation. • Incorrect starter signal. • ECM malfunction.

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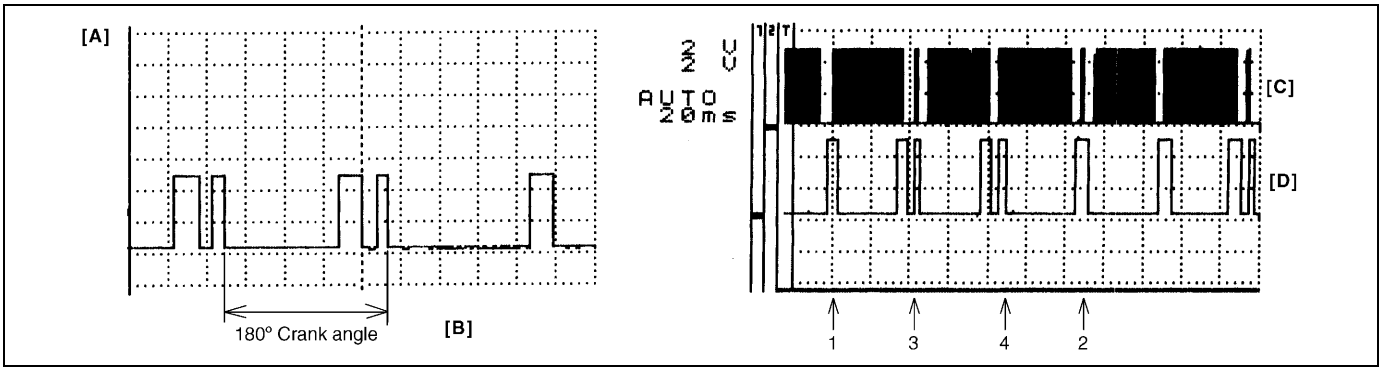
Reference

Connect oscilloscope between terminals C42-11 of ECM connector connected to ECM and body ground and check CMP sensor signal. When CKP circuit is failed (open or short), ECM identify the cylinder only by CMP sensor signal.



1. No.1 cylinder	3. No.3 cylinder	[A]: Oscilloscope Waveforms	[C]: CKP sensor signal
2. No.2 cylinder	4. No.4 cylinder	[B]: Waveforms at specified idle speed	[D]: CMP sensor signal

DTC Confirmation Procedure

1) Clear DTC.
2) Start engine and keep it at idle for 1 min.
3) Select “DTC” mode on scan tool and check DTC.

Troubleshooting

Step	Action	Yes	No
1	Was “Engine and Emission Control System Check” performed?	Go to Step 2.	Go to “Engine and Emission Control System Check”.
2	Check CMP Sensor and connector for proper installation. Is CMP sensor installed properly and connector connected securely?	Go to Step 3.	Correct.
3	Check Wire Harness and Connection. 1) Disconnect connector from CMP sensor. 2) Check for proper connection to CMP sensor at each terminal. 3) If OK, turn ignition switch ON and check for voltage at each terminal of sensor connector disconnected. See Fig. 1. Terminal “B+”: 10 – 14 V Terminal “Vout”: 4 – 5 V Terminal “GND”: 0 V Is check result satisfactory?	Go to Step 5.	Go to Step 4.
4	Was terminal “Vout” voltage out of specification in Step 3 check?	“RED/YEL” wire open, short or poor connection. If wire and connection are OK, substitute a known-good ECM and recheck.	“BLK/RED” or “BLK/ORN” wire open, short or poor connection.

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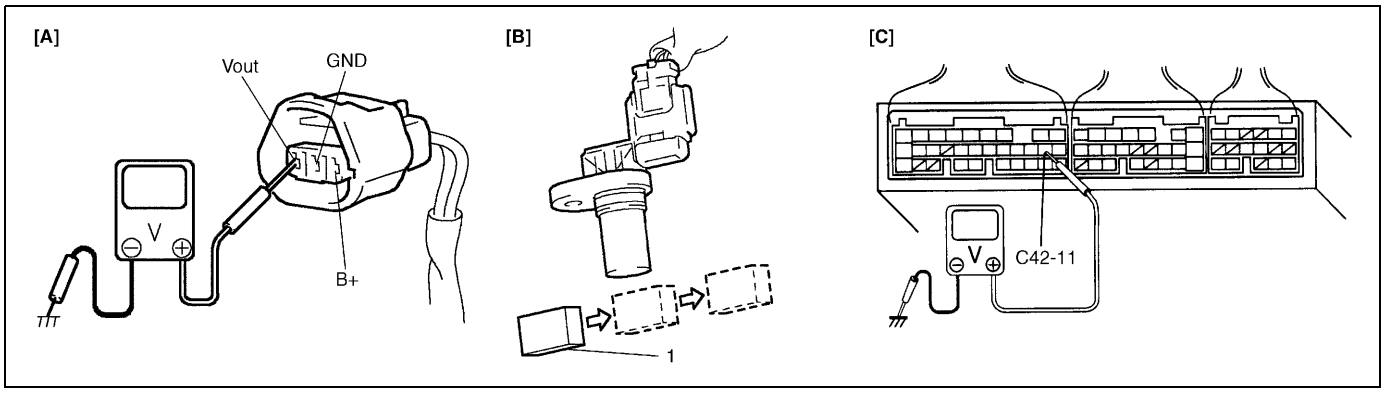
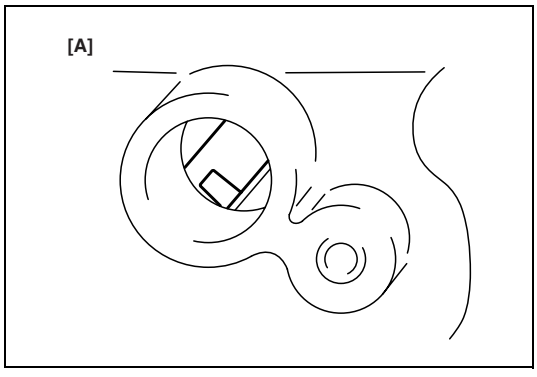
Step	Action	Yes	No
5	Check Ground Circuit for open. 1) Turn ignition switch OFF. 2) Check for continuity between “GND” terminal of CMP sensor connector and engine ground. Is continuity indicated?	Go to Step 6.	“BLK/ORN” wire open or poor ground connection.
6	Check CMP Sensor for operation. 1) Remove CMP sensor from sensor case. 2) Remove metal particles on end face of CMP sensor, if any. 3) Connect each connector to ECM and CMP sensor. 4) Turn ignition switch ON. 5) Check for voltage at terminal C42-11 of connector connected to ECM by passing magnetic substance (iron) while keeping approximately 1 mm (0.03 in.) gap with respect to end face of CMP sensor. See Fig. 2 and 3. Does voltage vary from low (0 – 1 V) to high (4 – 5 V) or from high to low?	Go to Step 7.	Replace CMP sensor.
7	Check Signal Rotor for the following. See Fig. 4. • Damage • No foreign material attached Is it in good condition?	Substitute a know-good ECM and recheck.	Clean rotor teeth or replace CMP sensor.



[A]: Fig. 1 for Step 3	[C]: Fig. 3 for Step 6
[B]: Fig. 2 for Step 6	1. Magnetic substance (iron)



[A]: Fig. 4 for Step 7

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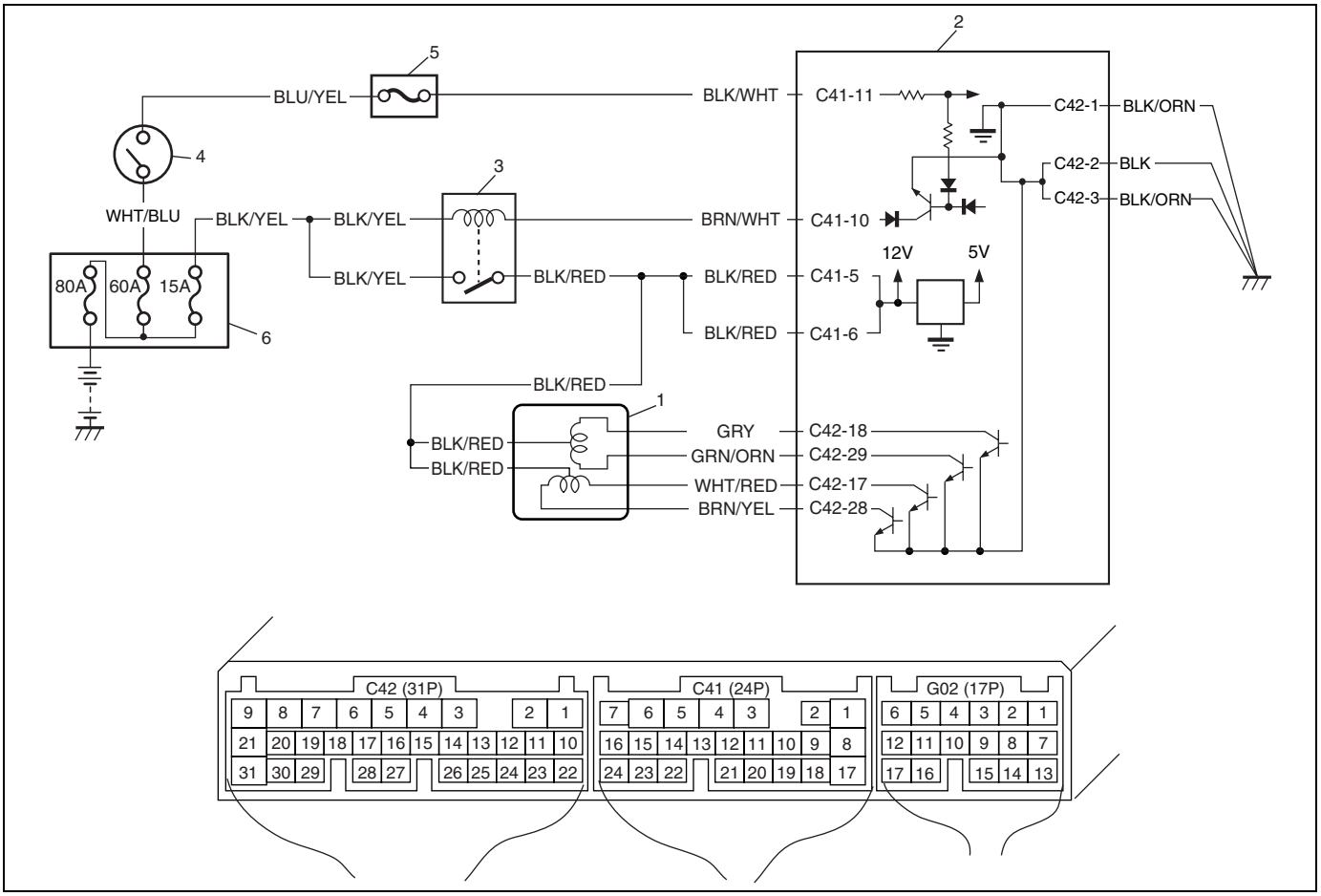
DTC P0400 Exhaust Gas Recirculation Flow Malfunction

Wiring Diagram



1. EGR valve	3. Main relay	5. "IG" fuse
2. ECM	4. Ignition switch	6. Main fuse box

DTC Detecting Condition and Trouble Area

DTC Detecting Condition	Trouble Area
• While running at specified vehicle speed after engine warm-up • During deceleration (engine speed high with closed throttle position ON) in which fuel cut is involved, difference in intake manifold absolute pressure between when EGR valve is opened at specified value and when it is closed is larger or smaller than specified value. ✱2 driving cycle detection logic, monitoring once/1 driving	• EGR valve or its circuit • EGR passage • ECM

DTC Confirmation Procedure

WARNING:

- **When performing a road test, select a place where there is no traffic or possibility of a traffic accident and be very careful during testing to avoid occurrence of an accident.**
- **Road test should be carried out with 2 persons, a driver and a tester, on a level road.**

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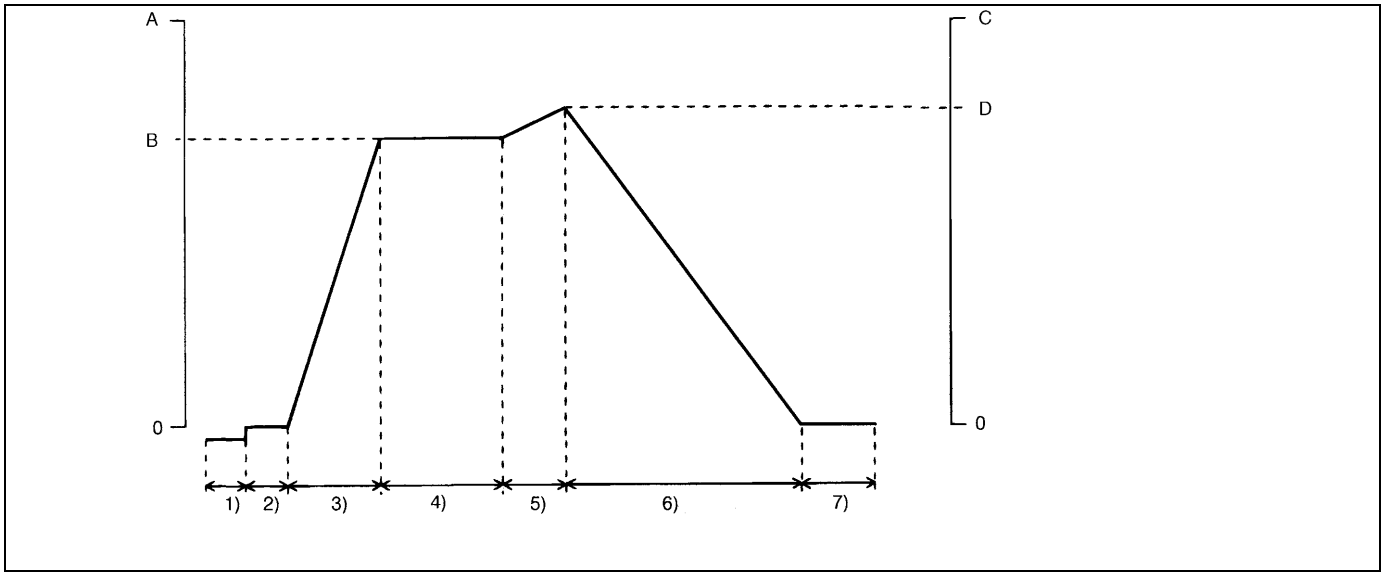
1) Turn ignition switch OFF.
   Clear DTC with ignition switch ON, check vehicle and environmental condition for:
   – Altitude (barometric pressure): 2400 m, 8000 ft or less (560 mmHg, 75 kPa or more)
   – Ambient temp.: –10°C, 14°F or higher
   – Intake air temp.: 70°C, 122°F or lower
2) Start engine and warm it up to normal operating temperature (70 – 110°C, 158 – 230°F) and run it at idle for 5 min.
3) Increase vehicle speed to 50 – 55 mph, 80 – 88 km/h in 5th gear or in “D” range.
4) Hold throttle valve at that opening position for 2 min. or longer.
5) Increase engine speed to 4000 r/min. in 3rd gear or in “2” range.
6) Release accelerator pedal and with engine brake applied, keep vehicle coasting (fuel cut condition) till engine speed reaches 1500 r/min.
7) Stop vehicle (don't turn ignition switch OFF) and confirm test results according to following “Test Result Confirmation Flow Table”.



A. Vehicle speed	C. Engine speed
B. 50 – 55 mph 80 – 88 km/h (Keep throttle valve opening constantly)	D. 4000 r/min

Test Result Confirmation Flow Table

Step	Action	Yes	No
1	Check DTC in “DTC” mode and pending DTC in “ON BOARD TEST”. Is DTC or pending DTC displayed?	Proceed to applicable DTC flow table.	Go to Step 2.
2	Set scan tool to “READINESS TESTS” mode and check if testing has been completed. Is test completed?	No DTC is detected. (Confirmation test is completed)	Repeat DTC confirmation procedure.

Troubleshooting

Step	Action	Yes	No
1	Was “Engine and Emission Control System Check” performed?	Go to Step 2.	Go to “Engine and Emission Control System Check”.
2	Do you have SUZUKI scan tool?	Go to Step 3.	Go to Step 5.

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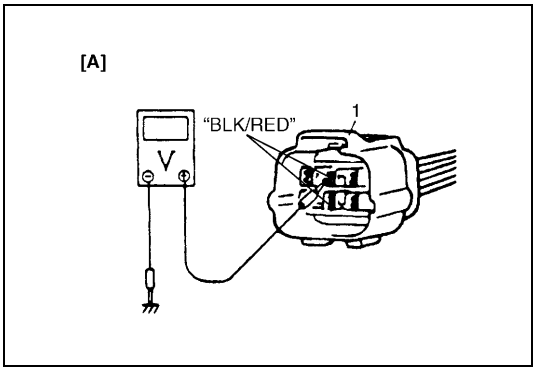
Step	Action	Yes	No
3	EGR Valve Operation Check: 1) With ignition switch OFF, install SUZUKI scan tool. 2) Check EGR system referring to “EGR system inspection” in Section 6E2. Is it in good condition?	Go to Step 4.	Go to Step 5.
4	MAP Sensor Check: 1) Check MAP sensor for performance referring to “MAP Sensor Check” in Section 6E2. Is check result satisfactory?	Intermittent trouble or faulty ECM. Check for intermittent referring to “Intermittent and Poor Connection” in Section 0A.	Repair or replace.
5	EGR Valve Power Supply Circuit Check: 1) With ignition switch OFF, disconnect EGR valve coupler. 2) With ignition switch ON, check voltage between terminal 2 and ground terminal 5 of EGR valve connector and ground. Is each voltage 10 – 14 V?	Go to Step 7.	Faulty “BLK/RED” wire.
6	EGR Valve Stepper Motor Coil Circuit Check: 1) With ignition switch OFF, connect EGR valve coupler and disconnect ECM couplers. 2) Check resistance between C42-17, 18, 28, 29. Is each resistance 20 – 24 Ω at 20°C, 68°F?	Go to Step 8.	Faulty “GRY” “GRN/ORN”, “WHT/RED”, “BRN/YEL” wire or EGR valve.
7	MAP sensor Check: 1) Check MAP sensor for performance referring to “MAP Sensor Check” Section 6E2. Is check result satisfactory?	EGR passage clogged or EGR valve malfunction. If all above are OK, intermittent trouble or faulty ECM. Check for intermittent referring to “Intermittent and Poor Connection” in Section 0A.	Repair or replace.



[A]: Fig. 1 for Step 5
1. EGR valve connector

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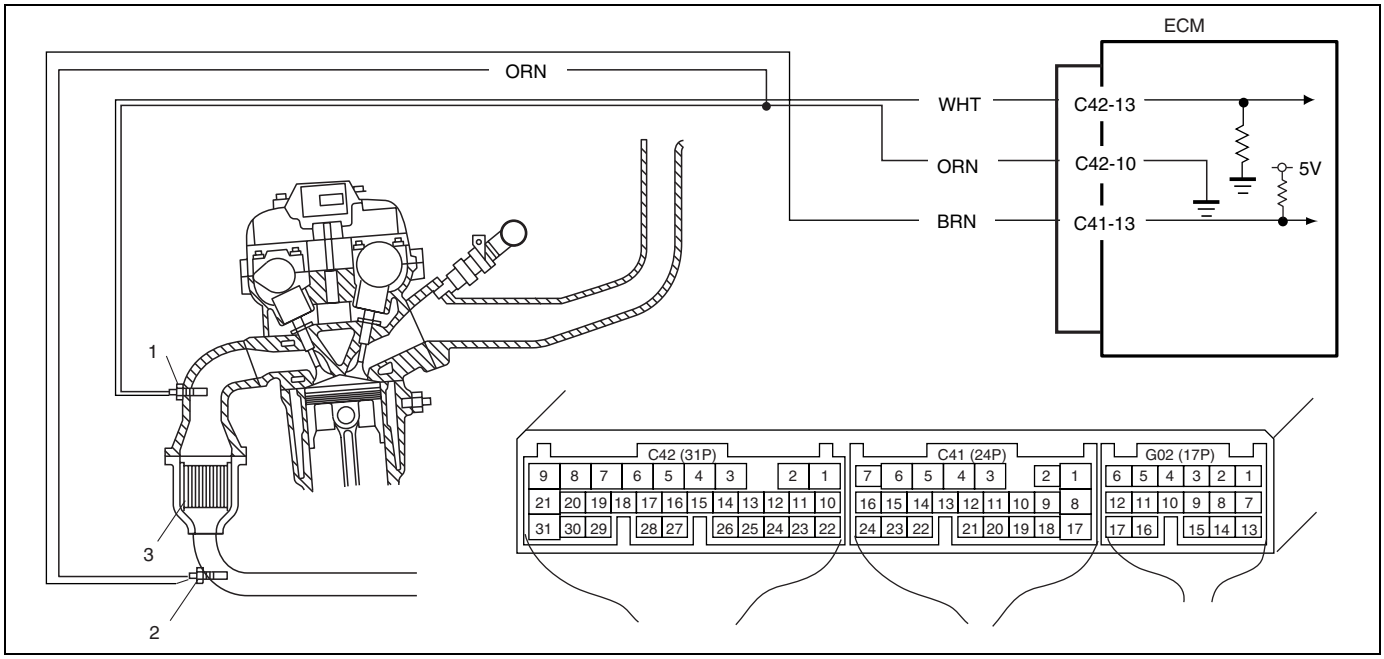
DTC P0420 Catalyst System Efficiency Below Threshold

System/Wiring Diagram

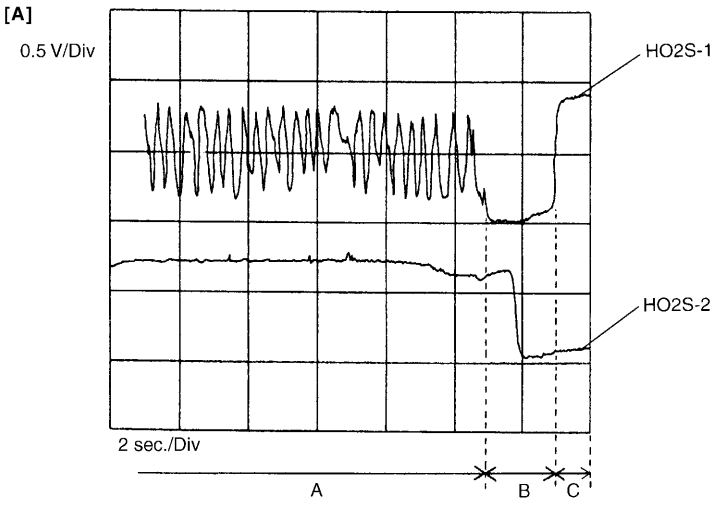


Circuit Description

ECM monitors oxygen concentration in the exhaust gas which has passed the three way catalytic converter by HO2S–2 (2).

When the catalyst is functioning properly, the variation cycle of HO2S–2 (2) output voltage (oxygen concentration) is slower than that of HO2S–1 (1) output voltage because of the amount of oxygen in the exhaust gas which has been stored in the catalyst (3).

Reference



[A]:	Oscilloscope Waveforms
A.	Engine running at Closed loop condition
B.	Fuel Cut
C.	Idle after fuel cut

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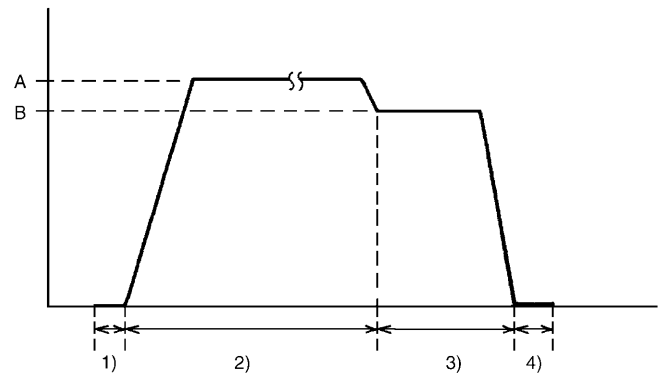
DTC Detecting Condition and Trouble Area

DTC Detecting Condition	Trouble Area
• While vehicle running at constant speed under other than high load. • Time from rich or lean switching command is output till HO2S–2 output voltage crosses 0.45 V is less than specified value. ✱2 driving cycle detection logic, monitoring once/1 driving	• Exhaust gas leak • Three way catalytic converter malfunction • Fuel system malfunction • HO2S–2 malfunction • HO2S–1 malfunction

DTC Confirmation Procedure

WARNING:
- **When performing a road test, select a place where there is no traffic or possibility of a traffic accident and be very careful during testing to avoid occurrence of an accident.**
- **Road test should be carried out with 2 persons, a driver and tester, on a level road.**

1) Turn ignition switch OFF.
   Clear DTC with ignition switch ON, check vehicle and environmental condition for:
   – Altitude (barometric pressure): 2400 m, 8000 ft or less (560 mmHg, 75 kPa or more)
   – Ambient temp.: –10°C, 14°F or higher
   – Intake air temp.: 70°C, 158°F or lower
   – Engine coolant temp.: 70 – 110°C, 158 – 230°F
2) Start engine and drive vehicle at 35 – 45 mph, 55 – 65 km/h for 8 min. or longer.
   While this driving, if “Catalyst Monitoring TEST COMPLETED” is displayed in “READINESS TESTS” mode and DTC is not displayed in “DTC” mode, confirmation test is completed.
   If “TEST NOT COMPLETE” is still being displayed, continue test driving.
3) Decrease vehicle speed at 30 – 40 mph, 50 – 60 km/h, and hold throttle valve at that opening position for 2 min. and confirm that short term fuel trim vary within – 20% – +20% range.
4) Stop vehicle (do not turn ignition switch OFF) and confirm test results according to following “Test Result Confirmation Flow Table”.



A. 35 – 45 mph (55 – 65 km/h)
B. 30 – 40 mph (50 – 60 km/h)

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Test Result Confirmation Flow Table

Step	Action	Yes	No
1	Check DTC in “DTC” mode and pending DTC in “ON BOARD TEST” or “PENDING DTC” mode. Is DTC or pending DTC displayed?	Proceed to applicable DTC Diag. Flow Table.	Go to Step 2.
2	Set scan tool to “READINESS TESTS” mode and check if testing has been completed. Is test completed?	No DTC is detected (confirmation test is completed).	Repeat DTC confirmation procedure.

Troubleshooting

Step	Action	Yes	No
1	Was “Engine and Emission Control System Check” performed?	Go to Step 2.	Go to “Engine and Emission Control System Check”.
2	Check Short Term Fuel Trim. Did short term fuel trim vary within – 20% – +20% range in step 3) of DTC confirmation test?	Go to Step 3.	Check fuel system. Go to DTC P0171/P0172 Diag. Flow Table.
3	Check HO2S–2 for Output Voltage. Perform steps 1) through 9) of DTC confirmation procedure for DTC P0136 (HO2S–2 malfunction) and check output voltage of HO2S–2 then. Is over 0.6 V and below 0.3 V indicated?	Replace three way catalytic converter.	Check “BRN” and “YEL” wires for open and short, and connections for poor connection. If wires and connections are OK, replace HO2S–2.

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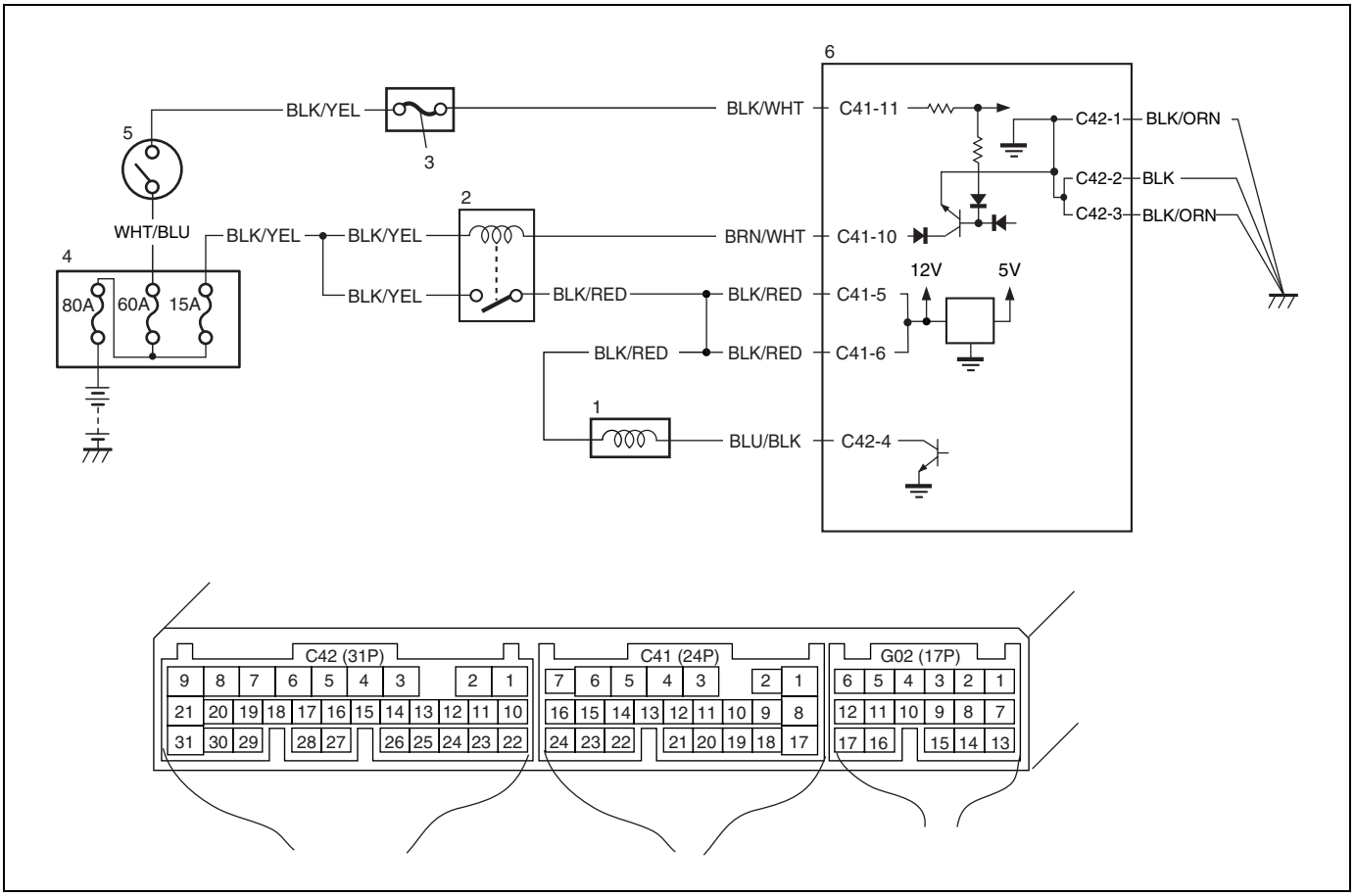
DTC P0443 Purge Control Valve Circuit Malfunction

Wiring Diagram



1. EVAP canister purge valve	3. "IG" fuse	5. Ignition switch
2. Main relay	4. Main fuse box	6. ECM

DTC Detecting Condition and Trouble Area

DTC Detecting Condition	Trouble Area
Canister Purge control valve circuit is opened or shorted.	• "BLU/BLK" circuit open or short • "BLK/RED" circuit open or short • Canister purge valve malfunction

DTC Confirmation Procedure

1) Clear DTC with ignition switch ON.
2) Select "DTC" mode on scan tool and check DTC.

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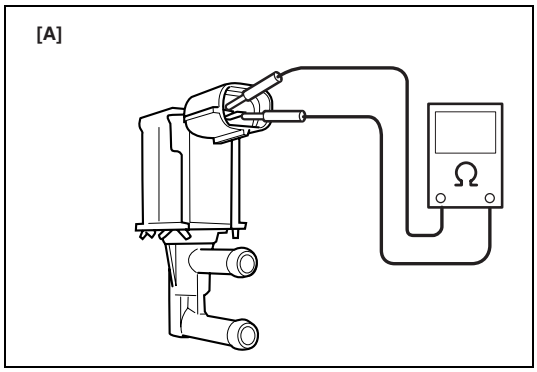
Troubleshooting

Step	Action	Yes	No
1	Check EVAP Canister Purge Valve operation. 1) With ignition switch OFF, disconnect coupler from canister purge valve. 2) Check resistance of EVAP canister purge valve. Resistance between two terminals: 30 – 34 Ω at 20°C (68°F) Resistance between terminal and body: 1 MΩ or higher Is it as specified?	"BLU/BLK" circuit open or short. "BLK/RED" circuit open or short.	Replace EVAP canister purge valve.



[A]: Fig. 1 for Step 1

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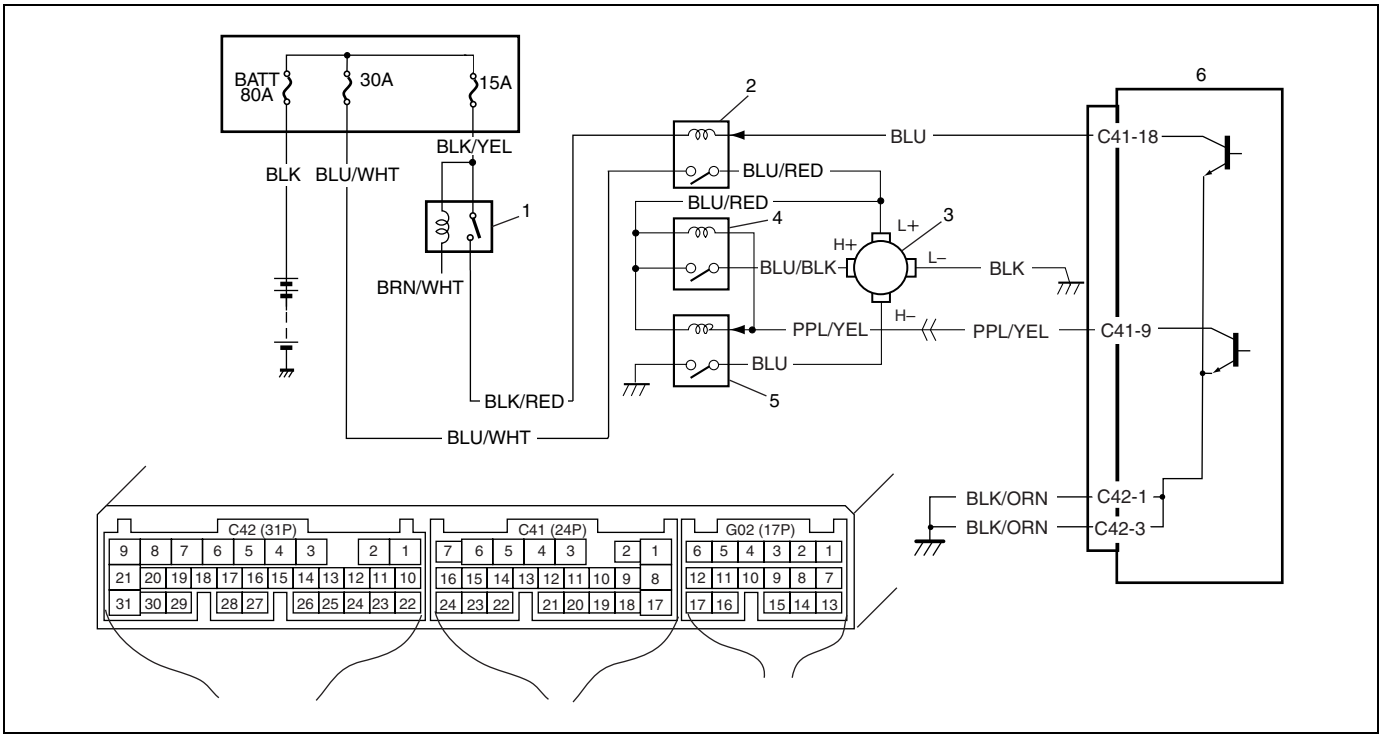
DTC P0480 Radiator Cooling Fan Control System Malfunction

Wiring Diagram



1. Main relay	4. Radiator fan relay No.2
2. Radiator fan relay No.1	5. Radiator fan relay No.3
3. Radiator fan motor	6. ECM

DTC Detecting Condition and Trouble Area

DTC Detecting Condition	Trouble Area
Low voltage at terminal C41-18 when engine coolant temp. is below 97.5°C, 207.5°F. ✱2 driving cycle detection logic, continuous monitoring.	• "BLK/RED" or "BLU" circuit open or short • Radiator cooling fan relay malfunction • ECM malfunction

DTC Confirmation Procedure

1) Turn ignition switch OFF.
2) Clear DTC with ignition switch ON.
3) Warm up engine until radiator cooling fan starts to operate.
4) Check pending DTC in "ON BOARD TEST" or "PENDING DTC" mode and DTC in "DTC" mode.

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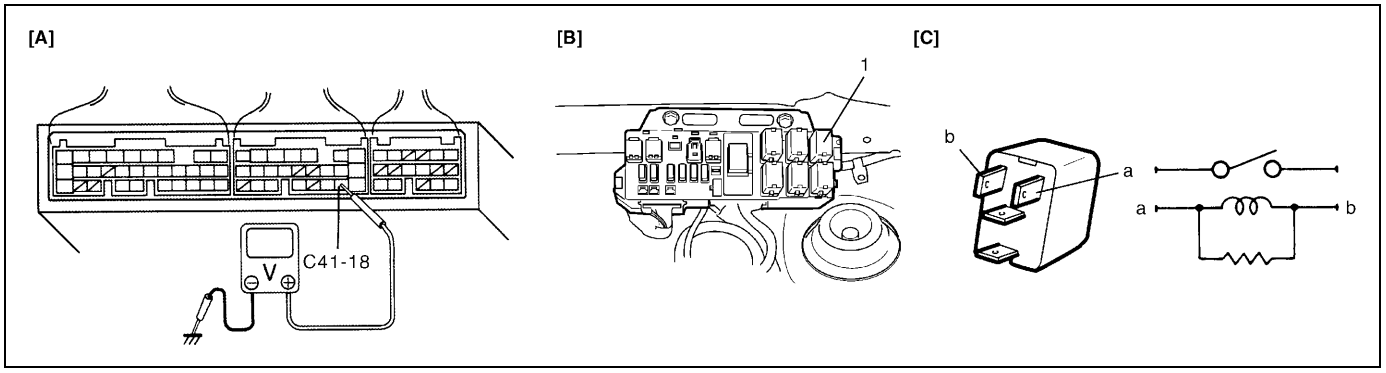
Troubleshooting

Step	Action	Yes	No
1	Was “Engine and Emission Control System Check” performed?	Go to Step 2.	Go to “Engine and Emission Control System Check”.
2	Check Radiator Cooling Fan Relay and Its Circuit. 1) Turn ignition switch ON. 2) Check for voltage at terminal C41-18 of ECM connector connected, under following condition. See Fig. 1. When engine coolant temp. is lower than 97.5°C, 207.5°F and A/C switch turns OFF: 10 – 14 V Is voltage as specified?	Intermittent trouble or faulty ECM. Check for intermittent referring to “Intermittent and Poor Connection” in Section 0A.	Go to Step 3.
3	Check Radiator Cooling Fan Control Relay. 1) Turn ignition switch OFF and remove radiator cooling fan relay. 2) Check for proper connection to the relay at “BLK/RED”, “BLU”, “BLU/RED” and “BLU/BLK” wire terminals. 3) If OK, then measure resistance between terminals a and b. See Fig. 2 and 3. Is it 56 – 146 Ω?	“BLK/RED” or “BLU” circuit open or short. If wires and connections are OK, substitute a known-good ECM and recheck.	Replace radiator cooling fan relay.



[A]: Fig. 1 for Step 2	[C]: Fig. 3 for Step 3
[B]: Fig. 2 for Step 3	1. Radiator fan relay No.1

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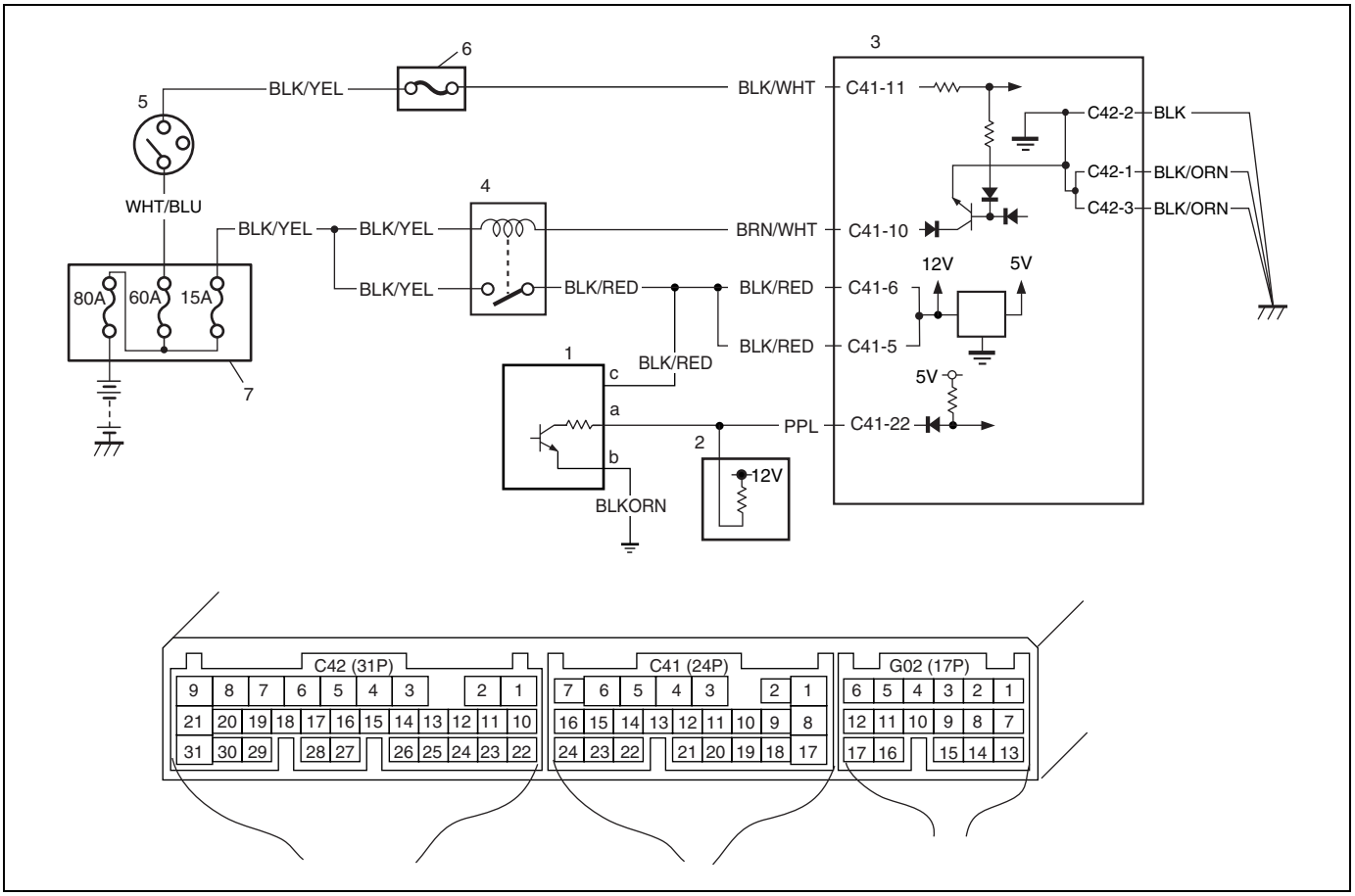
DTC P0500 (DTC No.16) Vehicle Speed Sensor (VSS) Malfunction

Wiring Diagram



1. VSS (vehicle speed sensor)	3. ECM	5. Ignition switch	7. Main fuse box
2. Combination meter and P/S control module and multi information display	4. Main relay	6. "IG" fuse	

DTC Detecting Condition and Trouble Area

DTC Detecting Condition	Trouble Area
• VSS signal not inputted while vehicle running or during fuel cut at deceleration. ✱2 driving cycle detection logic, continuous monitoring	• "BLK/ORN" circuit open • "PPL" or "BLK/RED" circuit open or short • VSS malfunction • ECM malfunction • Speedometer malfunction

DTC Confirmation Procedure

WARNING:
- **When performing a road test, select a place where there is no traffic or possibility of a traffic accident and be very careful during testing to avoid occurrence of an accident.**
- **Road test should be carried out with 2 persons, a driver and a tester.**

1) Clear DTC and warm up engine to normal operating temperature.
2) Increase vehicle speed to 50 mph, 80 km/h in 3rd gear or "2" range while observing vehicle speed displayed on scan tool.
3) Release accelerator pedal and with engine brake applied, keep vehicle coasting (fuel cut condition) for 4 sec. or more.
4) Check pending DTC and DTC.

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Troubleshooting

Step	Action	Yes	No
1	Was “Engine and Emission Control System Check” performed?	Go to Step 2.	Go to “Engine and Emission Control System Check”.
2	Does speedometer indicate vehicle speed?	Go to Step 3.	Go to Step 5.
3	Check Vehicle Speed Signal. Is vehicle speed displayed on scan tool in step 2) and 3) of DTC confirmation procedure?	Intermittent trouble or faulty ECM. Check for intermittent referring to “Intermittent and Poor Connection” in Section 0A.	Go to Step 4.
4	Check VSS Signal Circuit. 1) Turn ignition switch to OFF position. 2) Disconnect combination meter connectors and multi information display connectors. Refer to Section 8. 3) Disconnect P/S control module connector. 4) Turn ignition switch to ON position, without running engine. 5) Measure voltage from terminal “a” of VSS connector to ground. Is voltage within 4 – 5 V?	Faulty speedometer. Faulty P/S control module. Faulty multi information display.	“PPL” wire open or short. Poor connection of ECM connector terminal. If OK, substitute a known-good ECM and recheck.
5	Check VSS Power Supply. 1) With ignition switch at OFF position, disconnect VSS connector. 2) Turn ignition switch to ON position, without running engine. 3) Measure voltage from terminal “b” to “c” of VSS connector. See Fig. 1. Is voltage within 10 – 14 V?	Go to Step 6.	“BLK/RED” or “BLK/ORN” wire open or short.
6	Check VSS Signal Circuit. 1) Measure voltage from terminal “a” of VSS connector to ground. Is voltage more than 4 V?	Go to Step 7.	“PPL” wire open or short. Poor connection of ECM connector terminal. If OK, substitute a known-good ECM and recheck.
7	Check Signal Rotor. 1) Remove VSS. 2) Visually inspect VSS sensor signal rotor for damage. Was any damage found?	Faulty VSS signal rotor.	Poor connection of VSS connector terminal. If OK, substitute a known-good VSS and recheck.

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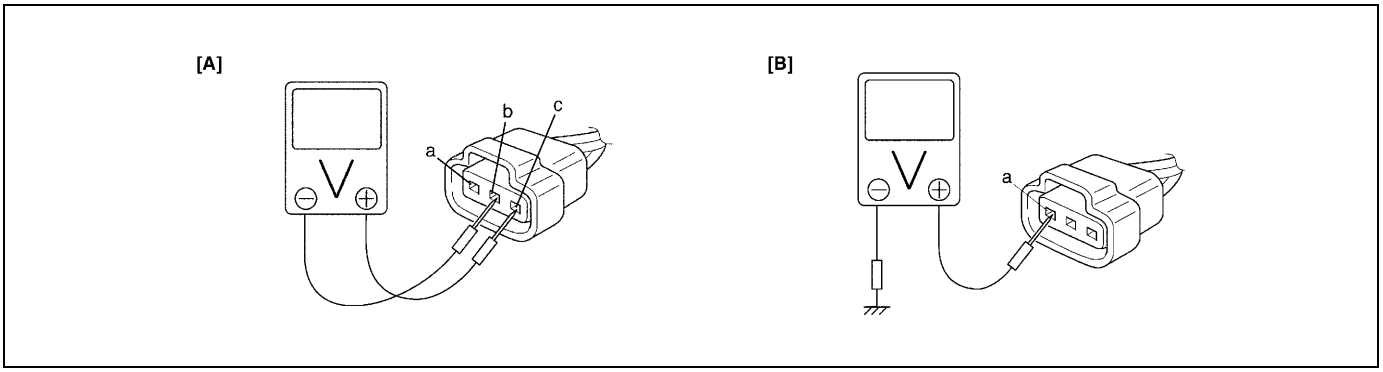

[A]: Fig. 1 for Step 5
[B]: Fig. 2 for Step 4 and Step 6

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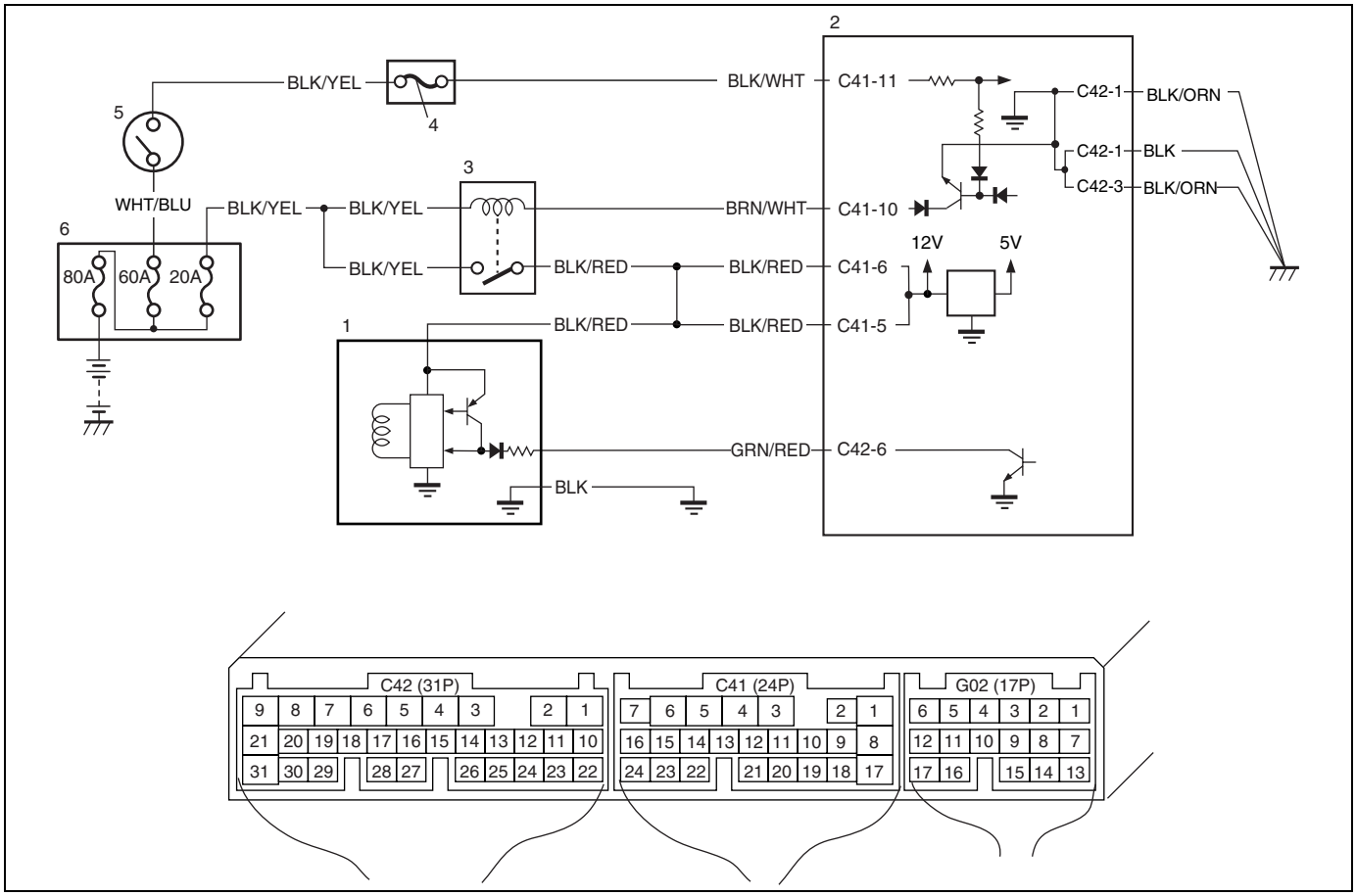
DTC P0505 (DTC No.26) Idle Control System Malfunction

Wiring Diagram



1. IAC valve	3. Main relay	5. Ignition switch
2. ECM	4. "IG" fuse	6. Main fuse box

DTC Detecting Condition and Trouble Area

DTC Detecting Condition	Trouble Area
• No closed signal to IAC valve is detected after engine start. ✱2 driving cycle detection logic, continuous monitoring.	• "BLK/RED", "GRN/RED" or "BLK" circuit open or short • IAC valve malfunction • ECM malfunction

DTC COnfirmation Procedure

1) Turn ignition switch OFF.
2) Clear DTC with ignition switch ON.
3) Start engine and run it at idle for 1 min.
4) Check DTC and pending DTC.

Troubleshooting

Step	Action	Yes	No
1	Was "Engine and Emission Control System Check" performed?	Go to Step 2.	Go to "Engine and Emission Control System Check".
2	Is SUZUKI scan tool available?	Go to Step 3.	Go to Step 4.

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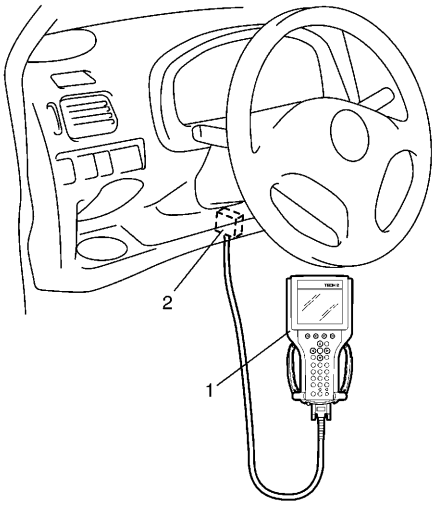
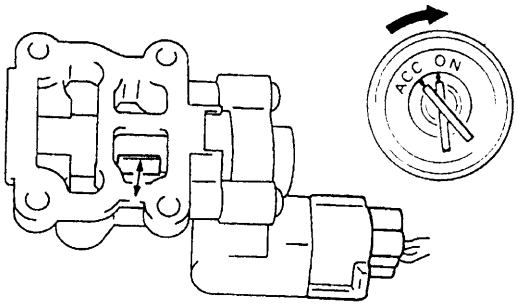
Step	Action	Yes	No
3	Check Idle Air Control System. 1) Connect SUZUKI scan tool (1) to DLC (2) with ignition switch OFF, set parking brake and block drive wheels. 2) Warm up engine to normal operating temperature. 3) Clear DTC and select “MISC TEST” mode on SUZUKI scan tool. See Fig. 1. Is it possible to control (increase and reduce) engine idle speed by using SUZUKI scan tool?	Intermittent trouble or faulty ECM. Check for intermittent referring to “Intermittent and Poor Connection” in Section 0A.	Go to Step 5.
4	Check Idle Air Control System. 1) Remove IAC valve from throttle body referring to “IAC Valve Removal” in Section 6E2. 2) Check IAC valve for operation referring to “IAC Valve Inspection” in Section 6E2. See Fig. 2. Is check result satisfactory?	Intermittent trouble or faulty ECM. Check for intermittent referring to “Intermittent and Poor Connection” in Section 0A.	Go to Step 5.
5	Check Wire Harness for open and short. 1) Turn ignition switch OFF. 2) Disconnect IAC valve connector. 3) Check for proper connection to IAC valve at each terminals. 4) If OK, disconnect ECM connector. 5) Check for proper connection to ECM at C42-6 terminal. 6) If OK, check “BLK/RED”, “GRN/RED” and “BLK” circuit for open and short. Are they in good condition?	Replace IAC valve and recheck.	Repair or replace.

[A]



[B]



[A]: Fig. 1 for Step 3
[B]: Fig. 2 for Step 4

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DTC P1450 Barometric Pressure Sensor Low/High Input
DTC P1451 Barometric Pressure Sensor Performance Problem

Wiring Diagram

Barometric pressure sensor is installed in ECM.

DTC Detecting Condition and Trouble Area

DTC Detecting Condition	Trouble Area
DTC P1450 : Barometric pressure : Sensor voltage is 4.7 V or higher, or 1.6 V or lower	• ECM (barometric pressure sensor) malfunction
DTC P1451 : • Vehicle stopped • Engine cranking • Difference between barometric pressure and intake manifold absolute pressure is 26 kPa, 200 mmHg or more • Difference between intake manifold absolute pressure at engine start and the pressure after engine start is 1.3 kPa, 10 mmHg or less. ✱2 driving cycle detection logic, monitoring once/1 driving.	• Manifold absolute pressure sensor and its circuit malfunction • ECM (barometric pressure sensor) malfunction

DTC Confirmation Procedure

1) Turn ignition switch OFF.
2) Clear DTC with ignition switch ON.
3) Turn ignition switch ON for 2 sec., crank engine for 2 sec. and run it at idle for 1 min.
4) Check pending DTC in “ON BOARD TEST” or “PENDING DTC” mode and DTC in “DTC” mode.

Troubleshooting

DTC P1450:

Substitute a known-good ECM and recheck.

DTC P1451:

NOTE:
Note that atmospheric pressure varies depending on weather conditions as well as altitude. Take that into consideration when performing these check.

Step	Action	Yes	No
1	Check Barometric Pressure Valve. 1) Connect scan tool (1) to DLC (2) with ignition switch OFF. 2) Turn ignition switch ON and select “DATA LIST” mode on scan tool. 3) Check manifold absolute pressure. See Fig. 1. Is it barometric pressure (approx. 100 kPa, 760 mmHg) at sea level?	Substitute a known-good ECM and recheck.	Go to Step 2.

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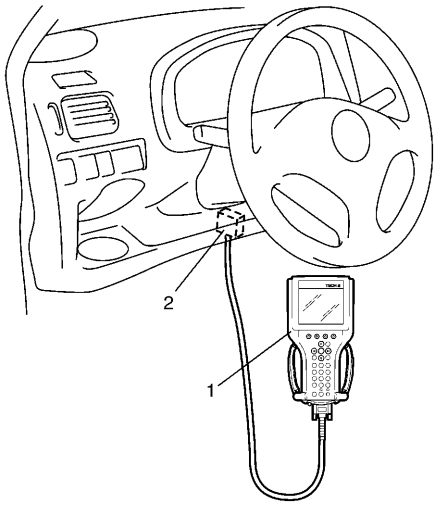
Step	Action	Yes	No
2	Check MAP Sensor. 1) Remove MAP sensor from intake manifold and connect vacuum pump gauge to MAP sensor. See Fig. 2. 2) Connect scan tool to DLC and turn ignition switch ON. 3) Check intake manifold absolute pressure displayed on scan tool for specified valve. See Table 1. Is check result satisfactory?	Check air intake system for air being drawn in and engine compression. If OK, then substitute a known-good ECM and recheck.	Replace MAP sensor.

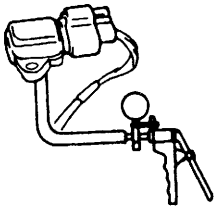
Table 1

Applying Vacuum	Displayed Value on Scan Tool
0	Barometric pressure (Approx. 100 kPa, 760 mmHg)
27 kPa 200 mmHg	Barometric pressure – 27 kPa (Approx. 73 kPa, 560 mmHg)
67 kPa 500 mmHg	Barometric pressure – 67 kPa (Approx. 33 kPa, 260 mmHg)

[A]



[B]



[A]: Fig. 1 for Step 1
[B]: Fig. 2 for Step 2

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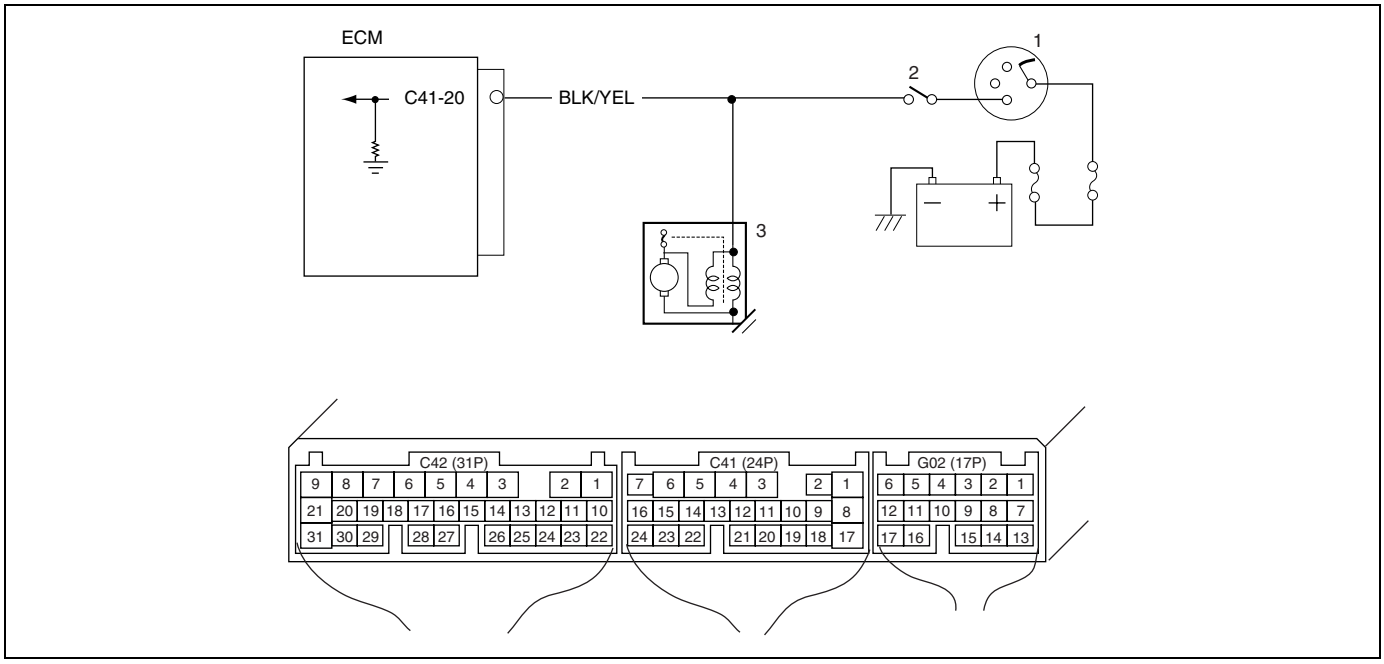
DTC P1500 Engine Starter Signal Circuit Malfunction

Wiring Diagram



1. Ignition switch	2. Transmission range switch (A/T)	3. Starter motor

DTC Detecting condition and Trouble Area

DTC Detecting Condition	Trouble Area
• Low voltage at terminal C41-20 when cranking engine or • High voltage at terminal C41-20 after starting engine. ✱2 driving cycle detection logic, continuous monitoring.	• "BLK/YEL" circuit open • ECM malfunction

DTC Confirmation Procedure

1) Turn ignition switch OFF.
2) Clear DTC with ignition switch ON, crank engine and run it at idle for 3 min.
3) Check pending DTC in "ON BOARD TEST" or "PENDING DTC" mode and DTC in "DTC" mode.

Troubleshooting

Step	Action	Yes	No
1	Was "Engine and Emission Control System Check" performed?	Go to Step 2.	Go to "Engine and Emission Control System Check".
2	Check Terminal Voltage. 1) Check for voltage at terminal C41-20 of ECM connector connected, under following condition. **While engine cranking: 6 – 10 V** **After starting engine: 0 V** Is voltage as specified?	Poor C41-20 connection or intermittent trouble. Check for intermittent referring to "Intermittent and Poor Connection" in Section 0A. If wire and connections are OK, substitute a known-good ECM and recheck.	"BLK/YEL" circuit open.

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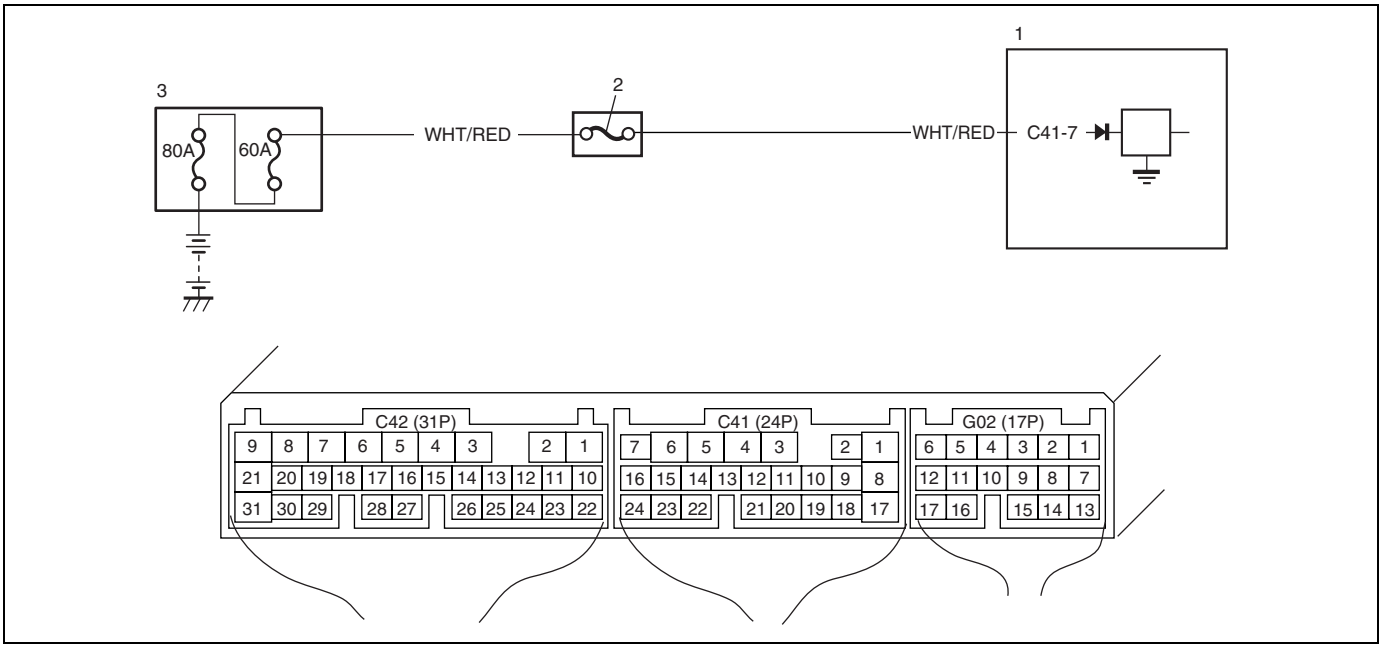
DTC P1510 ECM Back-up Power Supply Malfunction

Wiring Diagram



1. ECM	2. "RADIO DOME" fuse	3. Main fuse box

Circuit Description

Battery voltage is supplied so that diagnostic trouble code memory, values for engine control learned by ECM, etc. are kept in ECM even when the ignition switch is turned OFF.

DTC Detecting Condition and Trouble Area

DTC Detecting Condition	Trouble Area
• Low voltage at terminal C41-7 after starting engine.	• "WHT/RED" circuit open • ECM malfunction

DTC Confirmation procedure

1) Clear DTC, start engine and run it at idle for 1 min.
2) Select "DTC" mode on scan tool and check DTC.

Troubleshooting

Step	Action	Yes	No
1	Check Terminal Voltage. 1) Check for voltage at terminal C41-7 of ECM connector connected, under each condition, ignition switch OFF and engine running. Is it 10 – 14 V at each condition?	Poor C41-7 connection or intermittent trouble. Check for intermittent referring to "Intermittent and Poor Connection" in Section 0A. If wire and connections are OK, substitute a known- good ECM and recheck.	"WHT/RED" circuit open or "RADIO DOME" fuse blown.

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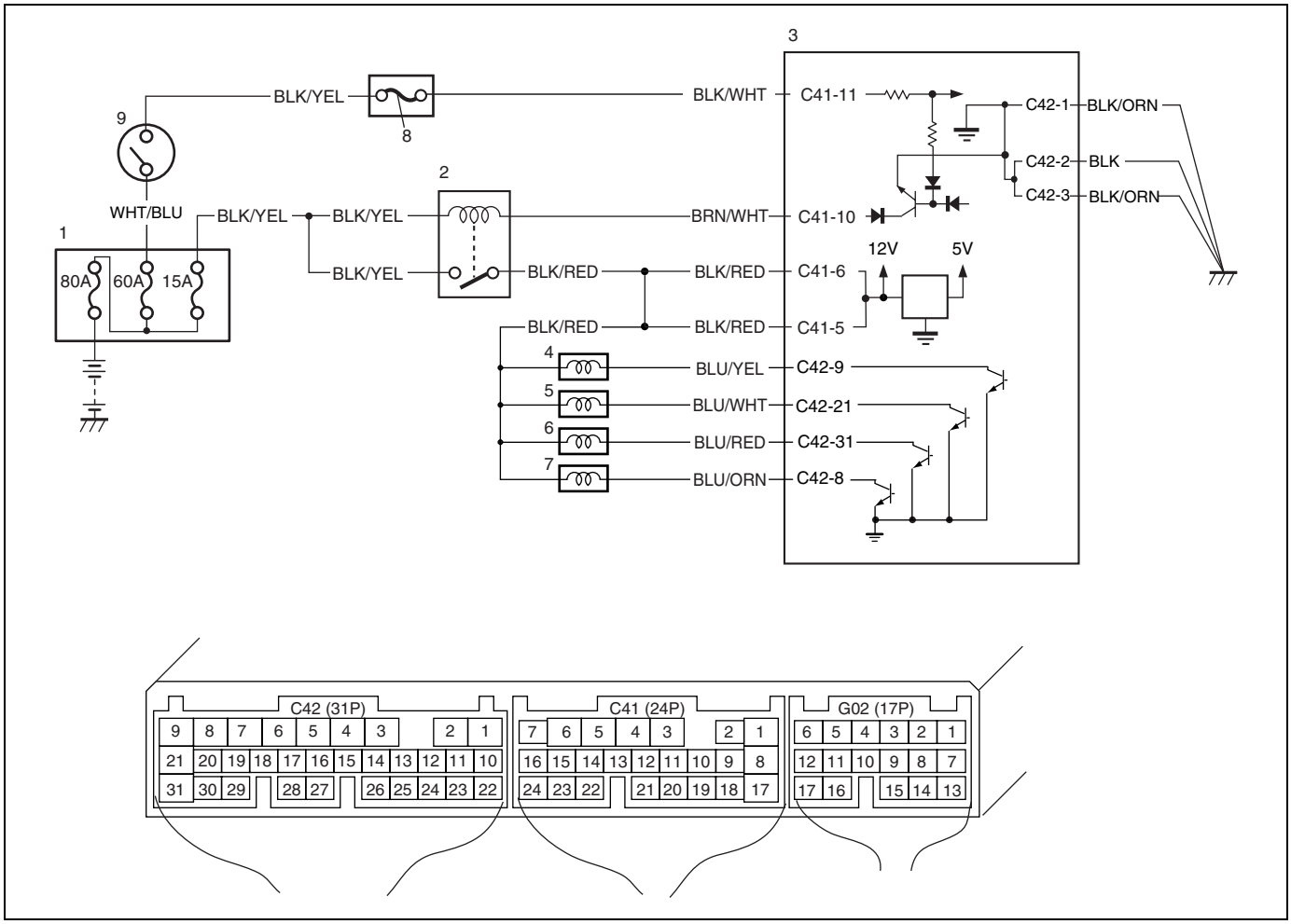
Table B-1 Fuel Injector Circuit Check

Wiring Diagram



1. Main fuse box	3. ECM	5. No.2 injector	7. No.4 injector	9. Ignition switch
2. Main relay	4. No.1 injector	6. No.3 injector	8. "IG" fuse	

Inspection

Step	Action	Yes	No
1	Check each injector for operating sound at engine cranking using sound scope. Do all 4 injector make operating sound?	Fuel injector circuit is in good condition.	Go to Step 2.
2	Check fuel injector resistance. 1) Disconnect connectors from fuel injectors with ignition switch turn OFF. 2) Check for proper connection to fuel injector at each terminals. 3) If OK, check all 4 fuel injectors for resistance, referring to "Fuel Injector Inspection" in Section 6E2. Are all injectors in good condition?	Go to Step 3.	Faulty fuel injector.
3	Check fuel injector insulation resistance. 1) Check that there is insulating between each fuel injector terminals and engine ground. Is there insulating?	Go to Step 4.	Faulty fuel injector.

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Step	Action	Yes	No
4	Check fuel injector power supply. 1) Measure voltage between each “BLK/RED” wire terminal and engine ground with ignition switch turned ON. Is voltage 10 – 14 V?	Go to Step 5.	“BLK/RED” wire in open circuit or shorted to ground circuit. If it is in good condition, go to diag flow table A-3.
5	Check wire circuit. 1) Turn OFF ignition switch. 2) Disconnect connectors from ECM. 3) Measure resistance between each “BLU/YEL”, “BLU/WHT”, “BLU/RED”, “BLU/ORN” wire terminal and vehicle body ground. Is resistance infinity?	Go to Step 6.	“BLU/YEL”, “BLU/WHT”, “BLU/RED”, “BLU/ORN” wire shorted to ground.
6	Check wire circuit. 1) Measure voltage between each “BLU/YEL”, “BLU/WHT”, “BLU/RED”, “BLU/ORN” wire terminal and vehicle body ground with ignition switch turned ON. Is voltage 0 V?	Go to Step 7.	“BLU/YEL”, “BLU/WHT”, “BLU/RED”, “BLU/ORN” wire shorted to power supply circuit.
7	Check fuel injector drive signal. 1) Connect connectors to each fuel injectors and ECM with ignition switch turned OFF. 2) Turn ON ignition switch. 3) Measure voltage “C42-9”, “E42-21”, “E42-31”, “E42-8” terminal and vehicle body ground. Is voltage 10 – 14 V?	Check fuel injector, referring to “Fuel Injector Inspection” in Section 6E2. If result in good condition, substitute a known-good ECM and recheck.	“BLU/YEL”, “BLU/WHT”, “BLU/RED”, “BLU/ORN” open circuit.

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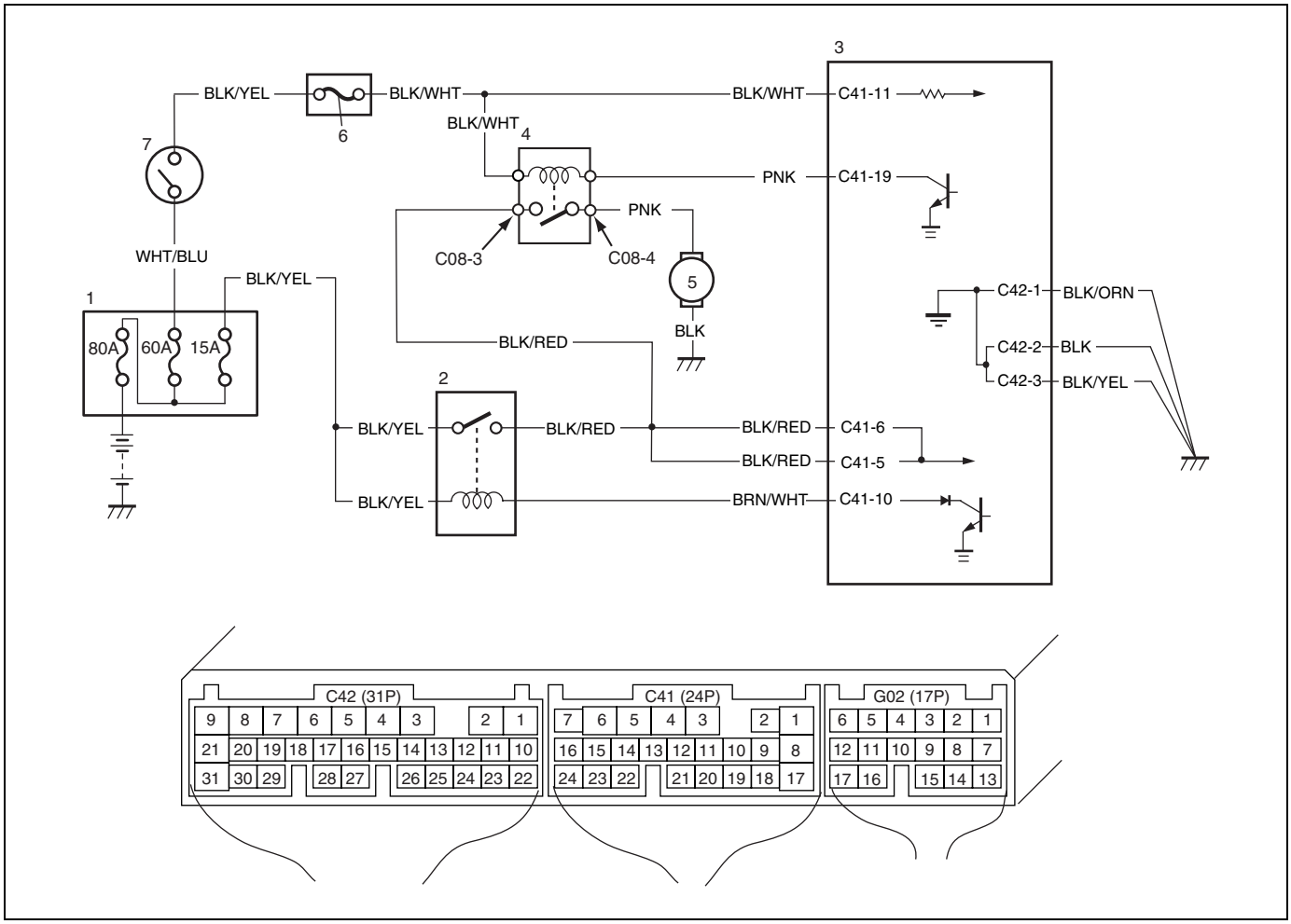
Table B-2 Fuel Pump and Its Circuit Check

Wiring Diagram



1. Fuel pump relay	2. Fuel pump

Inspection

CAUTION:
Check to make sure that connection is made between correct terminals. Wrong connection can cause damage to ECM, wire harness, etc.

Step	Action	Yes	No
1	Was “Engine and Emission Control System Check” performed?	Go to Step 2.	Go to “Engine and Emission Control System Check”.
2	Check Fuel Pump Control System for operation. See Fig. 1. Is fuel pump heard to operate for 2 sec. after ignition switch ON?	Fuel pump circuit is in good condition.	Go to Step 3.

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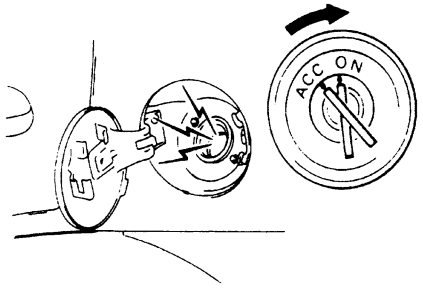
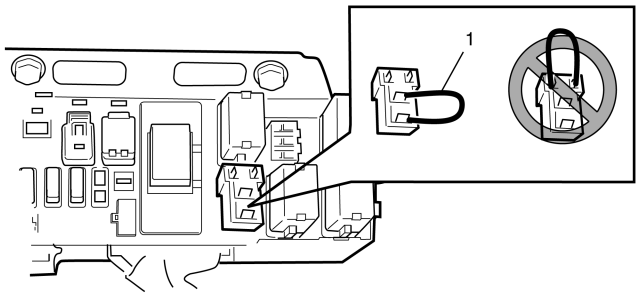
Step	Action	Yes	No
3	Check Fuel Pump for operation. 1) Remove fuel pump relay from relay box with ignition switch OFF. 2) Check for proper connection to relay at each terminal. 3) If OK, using service wire (1), connect terminals C08-3 and C08-4 of relay connector. See Fig. 2. Is fuel pump heard to operate at ignition switch ON?	Go to Step 4.	"PNK", "BLK" or "BLK/RED" circuit open or fuel pump malfunction.
4	Check Fuel Pump Relay for operation. 1) Check resistance between each two terminals of fuel pump relay. See Fig.3. **Between terminals "c" and "d": Infinity** **Between terminals "a" and "b": 56 – 146 Ω** 2) Check that there is continuity between terminals "c" and "d" when battery is connected to terminals "a" and "b". See Fig. 3. Is fuel pump relay in good condition?	"PNK" circuit open or poor C41-19 connection. If wire and connection are OK, substitute a known-good ECM and recheck.	Replace fuel pump relay.

[A]

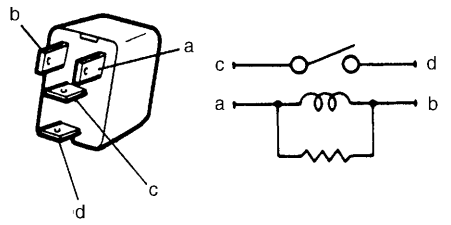


[B]



[A]: Fig. 1 for Step 2
[B]: Fig. 2 for Step 3

[A]



[A]: Fig. 3 for Step 4

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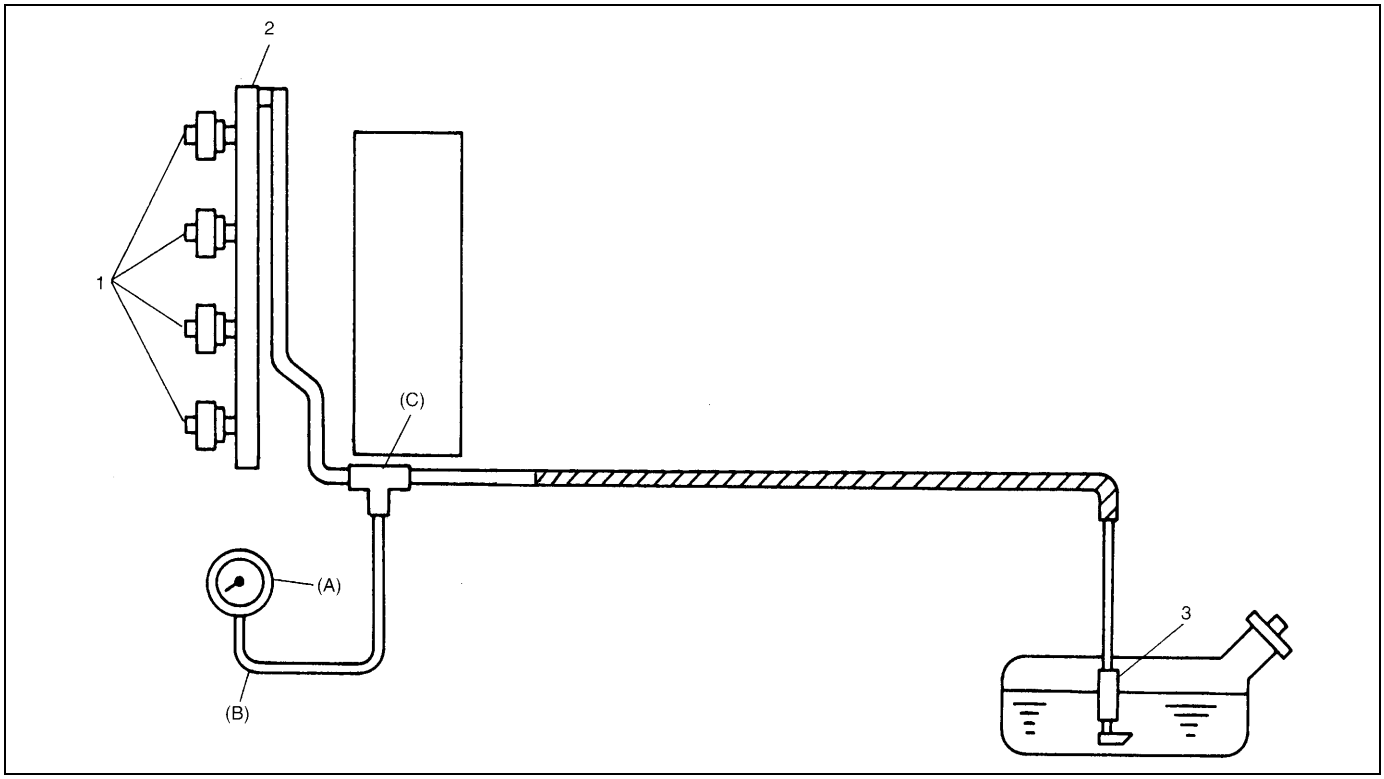
Table B-3 Fuel Pressure Check

System/Wiring Diagram



1. Injector	(A): Fuel pressure gauge
2. Delivery pipe	(B): Hose
3. Fuel pump	(C): Attachment

Inspection

Step	Action	Yes	No
1	Check Fuel Pressure (Refer to Section 6E2 for details). 1) Release fuel pressure from fuel feed line. 2) Install fuel pressure gauge. 3) Check fuel pressure by repeating ignition switch ON and OFF. See Fig. 1. Is fuel pressure then 270 – 310 kPa (2.7 – 3.1 kg/cm^2, 38.4 – 44.0 psi)?	Go to Step 2.	Go to Step 4.
2	Is 250 kPa (2.5 kg/cm^2, 35.6 psi) or higher fuel pressure retained for 1 minute after fuel pump is stopped at Step 1?	Normal fuel pressure.	Go to Step 3.
3	Is there fuel leakage from fuel feed line hose, pipe or their joint?	Fuel leakage from hose, pipe or joint.	Faulty fuel pressure regulator.
4	Was fuel pressure higher than spec. in Step 1?	Faulty fuel pressure regulator.	Clogged fuel filter, Restricted fuel feed hose or pipe, Faulty fuel pump or Fuel leakage from hose connection in fuel tank.

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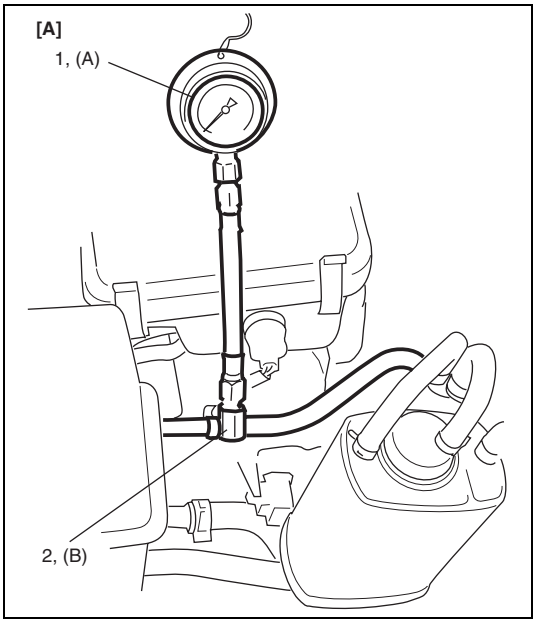

[A]:	Fig. 1 for Step 1
1.	Fuel pressure gauge
2.	3 way joint

Special tool
(A): 09912-58442
(B): 09912-58490

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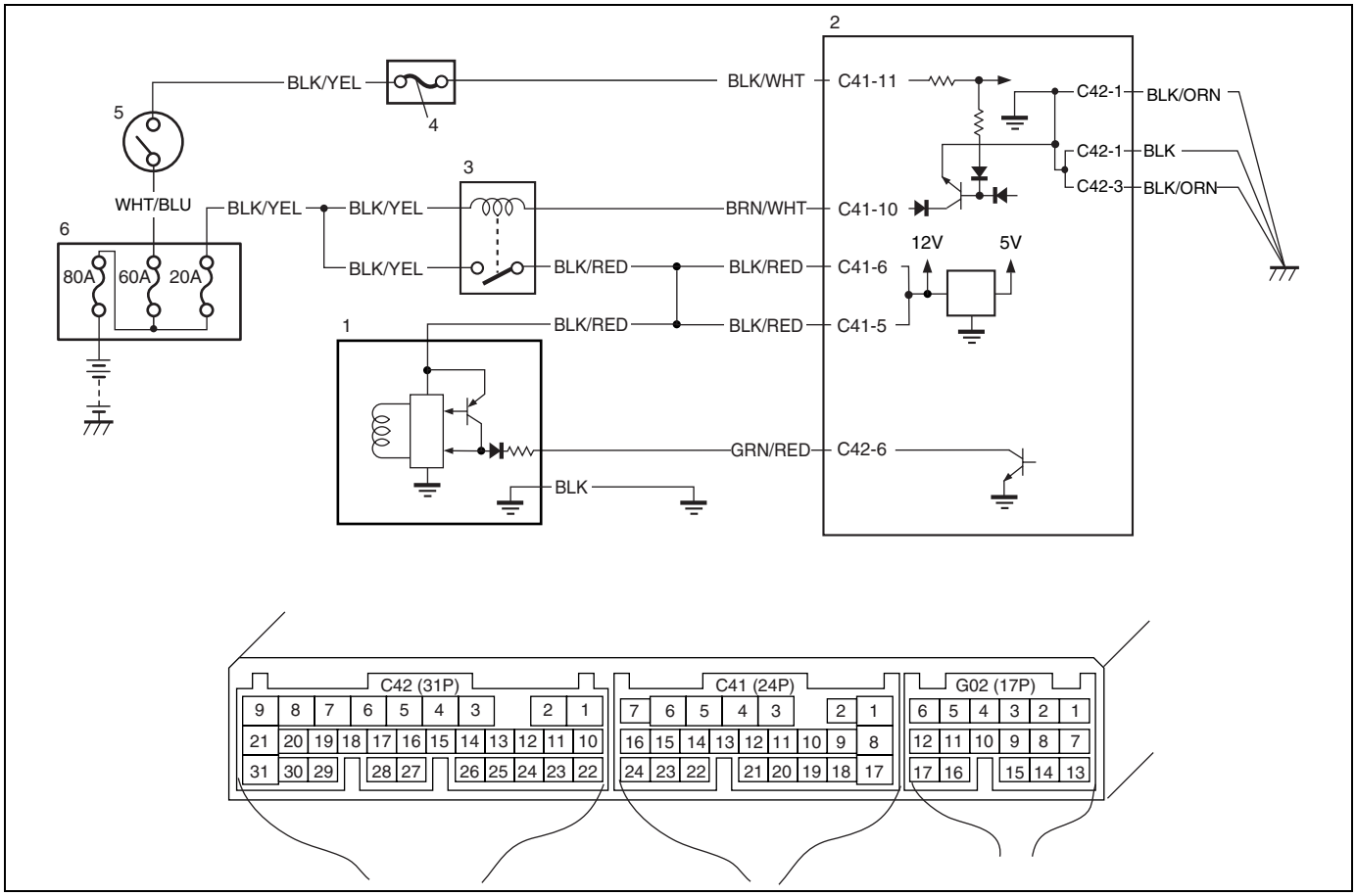
Table B-4 Idle Air Control System Check

Wiring Diagram



1. IAC valve	3. Main relay	5. Ignition switch
2. ECM	4. "IG" fuse	6. Main fuse box

Inspection

Step	Action	Yes	No
1	Check engine idle speed and IAC duty referring to "Idle Speed/IAC Duty Inspection" in Section 6E1. Is idle speed within specification?	Go to Step 2.	Go to Step 4.
2	Is IAC duty within specification in Step 1?	Go to Step 3.	Check for followings : Vacuum leak EVAP canister purge control system Clog of IAC air passage Accessory engine load Closed throttle position (TP sensor) Stuck of PCV valve
3	Is engine idle speed kept specified speed even with headlight ON?	System is in good condition.	Check IAC system for operation referring to Step 2 of DTC P0505 Diag. Flow Table.

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Step	Action	Yes	No
4	Was idle speed higher than specification in Step 1?	Go to Step 5.	Go to Step 6.
5	Check A/C (input) signal circuit referring to Step 1 of Table B-5 A/C Signal Circuit Check, if equipped. (A/C signal can be also checked by using SUZUKI scan tool.) Is it in good condition?	Go to Step 6.	Repair or replace A/C signal circuit or A/C system.
6	Check IAC system referring to Step 2 of DTC P0505 Diag. Flow Table. Is check result satisfactory?	Go to Step 7.	Go to Step 3 of DTC P0505 Diag. Flow Table.
7	Was IAC duty less than about 3% (or more than about 97% for OFF duty meter) in Step 1 of this table?	Check abnormal air inhaling from air intake system, PCV valve and EVAP canister purge control system.	Check TP sensor (closed throttle position) and ECT sensor for performance. If sensors are OK, substitute a known-good ECM.

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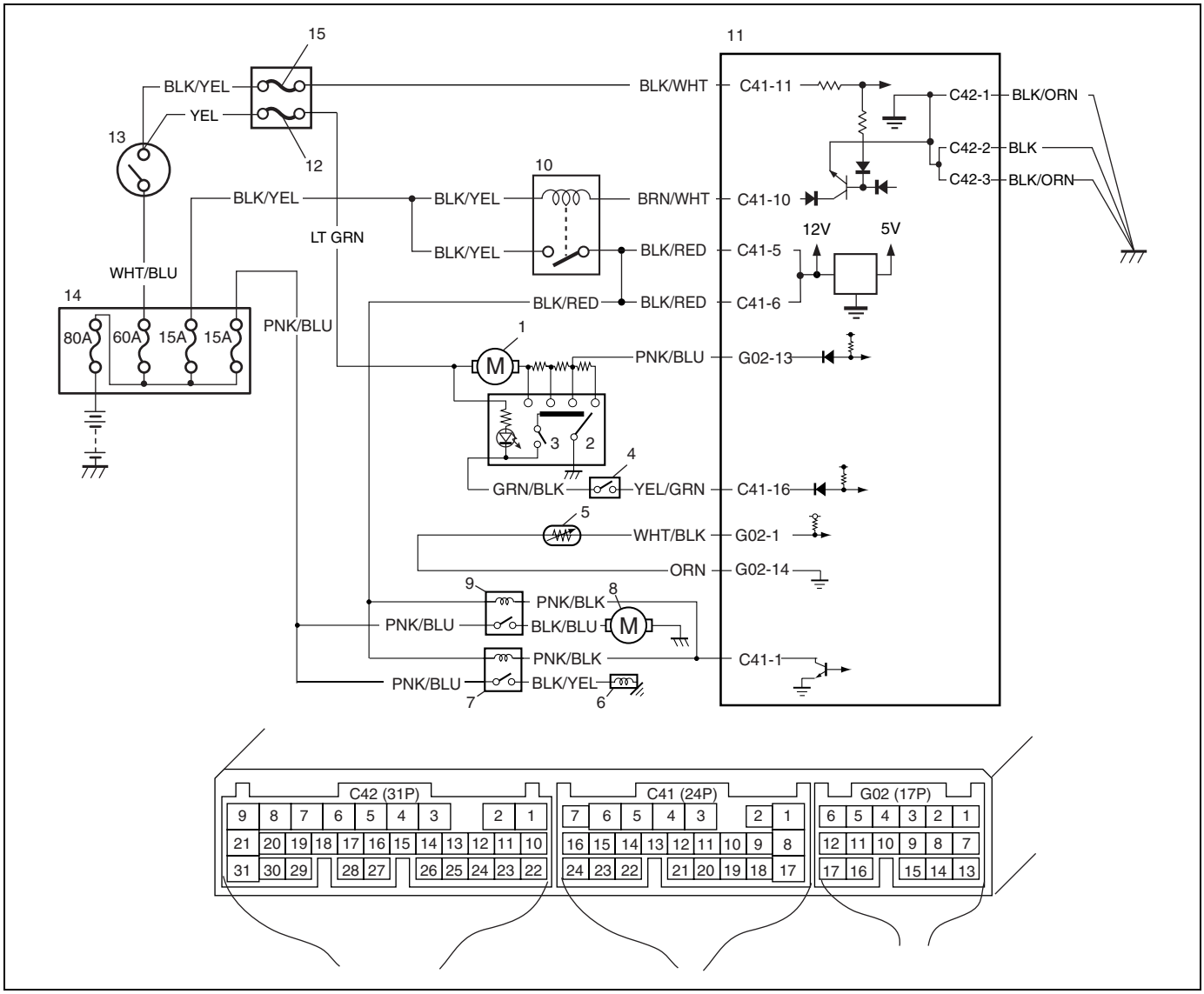
Table B-5 A/C Signal Circuits Check (Vehicle with A/C)



1. Blower fan motor	5. A/C evaporator temp. sensor	9. A/C condenser fan relay	13. Ignition switch
2. Blower fan switch	6. A/C compressor clutch	10. Main relay	14. Main fuse box
3. A/C switch	7. A/C compressor relay	11. ECM	15. “IG” fuse
4. A/C pressure switch	8. A/C condenser fan	12. “HTR” fuse	

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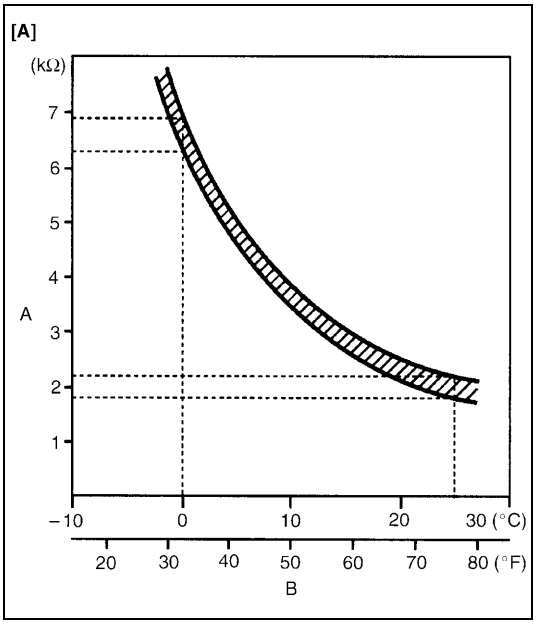
Inspection

Step	Action	Yes	No
1	Check evaporator temp. sensor resistance. 1) Disconnect ECM connectors with ignition switch at OFF position. 2) Check resistance between G02-1 terminal and G02-14 terminal. See Fig. 1. Is it within specification? **At 0°C 6.3 – 6.9 kΩ** **At 25°C 1.8 – 2.2 kΩ**	Go to Step 2.	Faulty A/C evaporator temp. sensor or its circuit.
2	Check A/C switch signal. 1) Check voltage at C41-16 terminal under each condition given below. **Ignition switch ON A/C switch OFF** **: 10 – 14V** **Ignition switch ON A/C switch ON** **: 0 – 1V** Is check result satisfactory?	Go to Step 3.	"YEL/GRN" wire open or short Poor C41-16 terminal connection If wire and connection are OK, substitute a known-good ECM and recheck. Go to Step 3.
3	1) Check voltage at C41-1 terminal under each condition given below. **While engine running, A/C switch OFF** **: 0 V** **While engine running, A/C switch ON** **: 10 – 14V** Is check result satisfactory?	A/C control system circuits are in good condition.	"PNK/BLK" wire open or short Poor C41-1 terminal connection If wire and connection are OK, substitute a known-good ECM and recheck.

NOTE:

When A/C evaporator thermistor temp. is below 2.5°C (36.5°F), A/C remain OFF (C41-1 terminal voltage become 0 – 1 V). This condition is not abnormal.



[A]: Fig. 1 for Step 1
A. Resistance
B. Temperature

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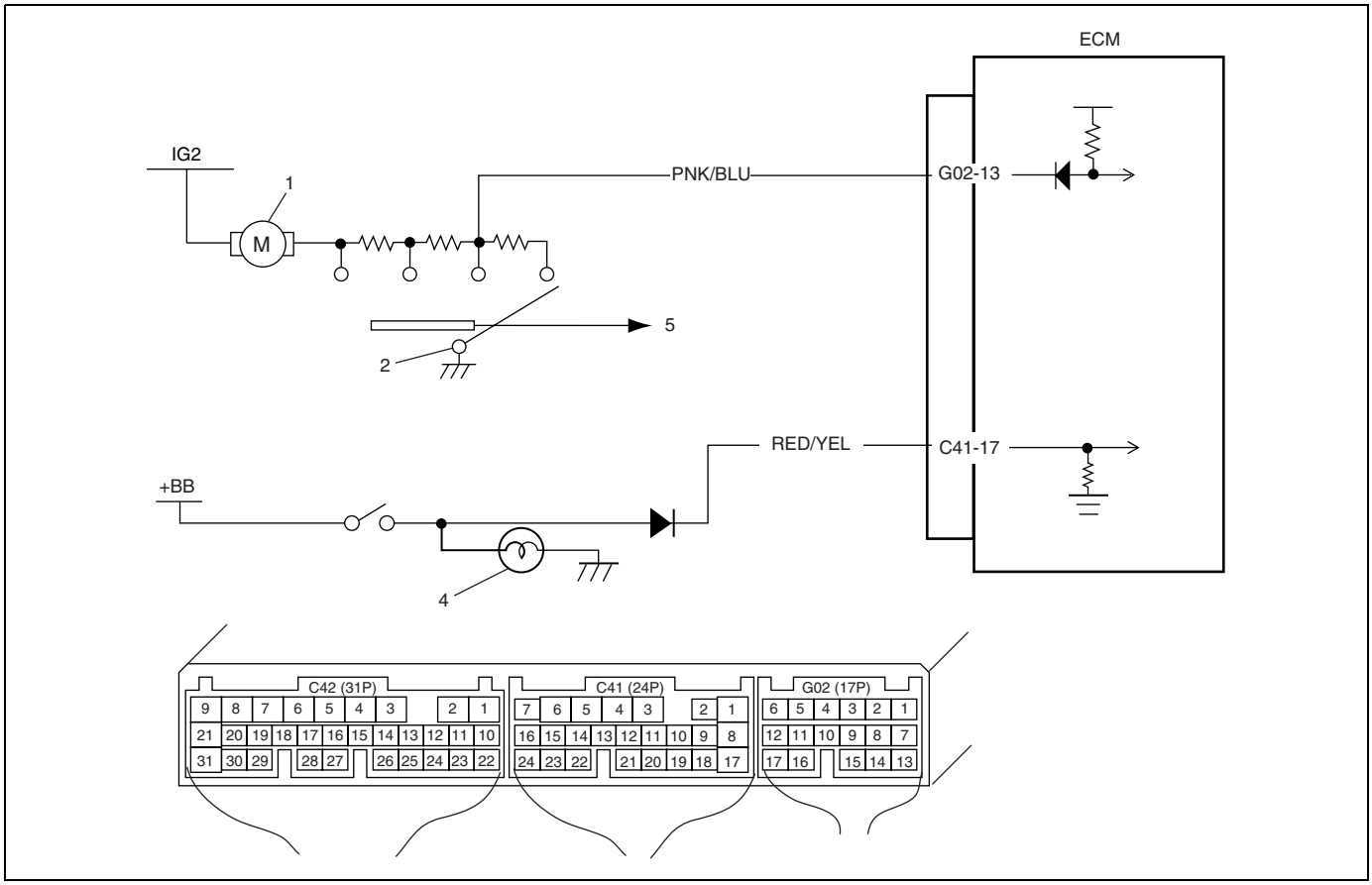
Table B-6 Electric Load Signal Circuit Check



1. Blower fan motor	3. Rear defogger	5. To A/C switch
2. Blower fan switch	4. Position lamp	

Inspection

Step	Action	Yes	No
1	Is SUZUKI scan tool available?	Go to Step 2.	Go to Step 3.
2	Check Electric Load Signal Circuit. 1) Connect SUZUKI scan tool (1) to DLC (2) with ignition switch OFF. 2) Start engine and select “DATA LIST” mode on scan tool. 3) Check electric load signal under following each condition. See Fig. 1 and Table 1. Is check result satisfactory?	Electric load signal circuit is in good condition.	C41-17 and/or “PNK/BLU” circuit open or short, Electric load diodes malfunction or Each electric load circuit malfunction.
3	Check Electric Load Signal Circuit. 1) Turn ignition switch ON. 2) Check voltage at each terminals C41-17 and G02-13 of ECM connector connected, under above each condition. See Fig. 3 and Table 1. Is each voltage as specified?	Electric load signal circuit is in good condition.	C41-17 and/or “PNK/BLU” circuit open or short, Electric load diodes malfunction or Each electric load circuit malfunction.

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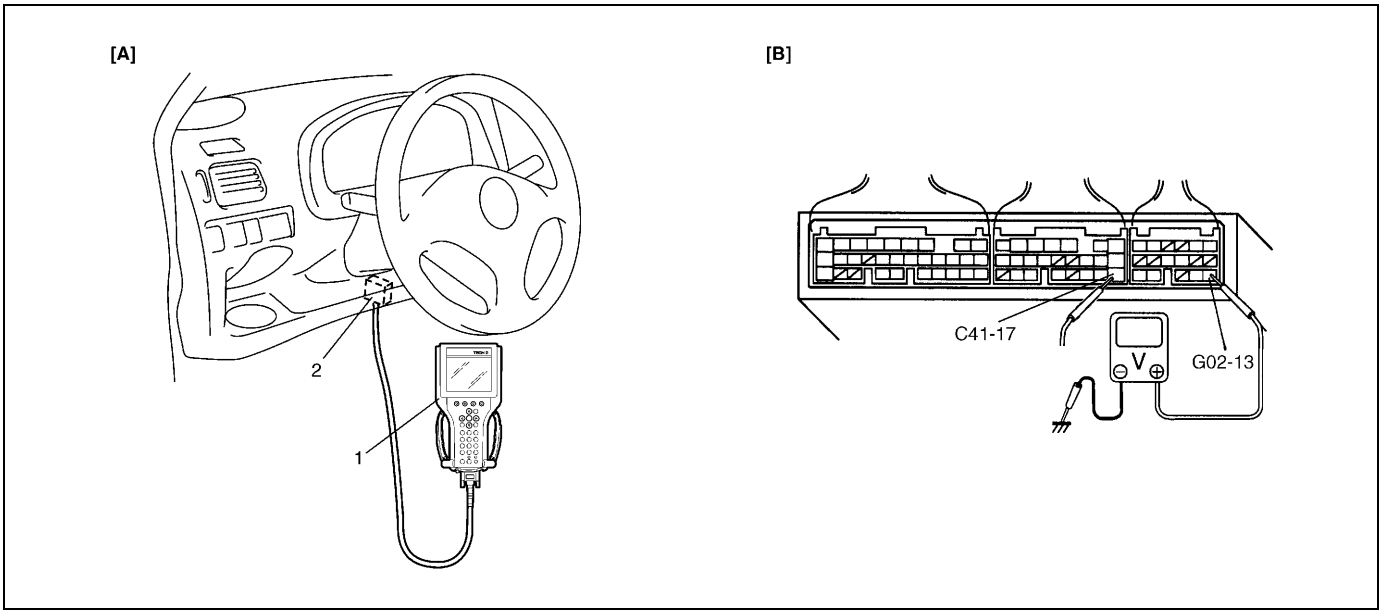

[A]: Fig. 1 for Step 2
[B]: Fig. 2 for Step 3

Table 1 for Step 2 and 3

		Scan tool or voltmeter		
		SUZUKI SCAN TOOL	VOLTAGE AT C41-17	VOLTAGE AT G02-13
Ignition switch, Small light and heater blower fan all turned ON/OFF	OFF	OFF	0 V	10 – 14 V
	ON	ON	10 – 14 V	0 V

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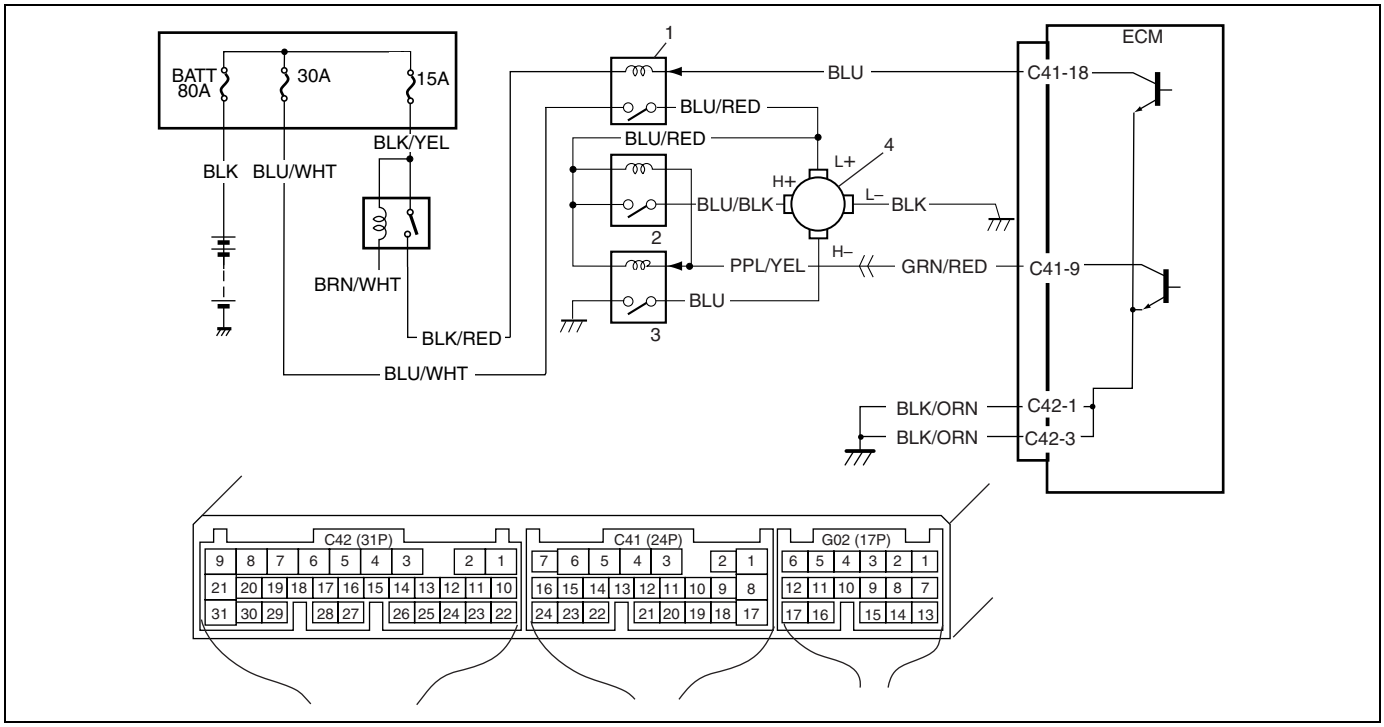
Table B-7 Radiator Fan Control System Check



1. Radiator fan relay No.1	3. Radiator fan relay No.3
2. Radiator fan relay No.2	4. Radiator fan

Inspection

Step	Action	Yes	No
1	Check Fan Control System. 1) Connect scan tool (1) to DLC (2) with ignition switch OFF. 2) Start engine and select “DATA LIST” mode on scan tool. 3) Warm up engine until coolant temp. is 97.5°C, 208°F or higher and A/C switch turn OFF. (If engine coolant temp. does not rise, check engine cooling system or ECT sensor.) See Fig. 1. Is radiator cooling fan started when engine coolant temp. reached above temp.?	Radiator cooling fan control system is in good condition.	Go to Step 2.
2	Check Radiator Fan Relay and Its Circuit. 1) Check DTC and pending DTC with scan tool. Is DTC P0480 displayed?	Go to DTC P0480 Diag. Flow Table.	Go to Step 3.
3	Check Radiator Fan Relays. 1) Turn ignition switch OFF and remove radiator cooling fan relays. (No.1 – No.3) 2) Check for proper connection to relay at terminals “c” and “d”. 3) If OK, check that there is continuity between “c” and “d” when battery is connected to terminals “a” and “b”. See Fig. 3. Is check result satisfactory?	Go to Step 4.	Replace radiator fan relay(s).

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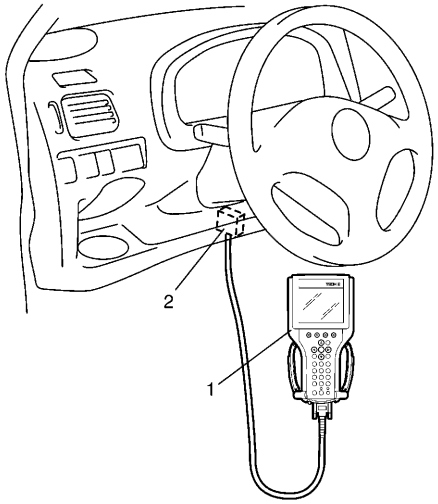
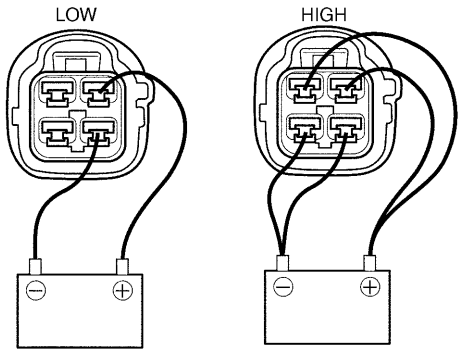
Step	Action	Yes	No
4	Check Radiator Fan. 1) Turn ignition switch OFF. 2) Disconnect cooling fan motor connector. 3) Check for proper connection to motor at “BLU/RED” and “BLK” terminals. 4) If OK, connect battery to motor and check for operation. See Fig. 2. Is it in good condition?	“BLU/WHT”, “BLU/RED” or “BLK” circuit open.	Replace radiator fan motor.

[A]

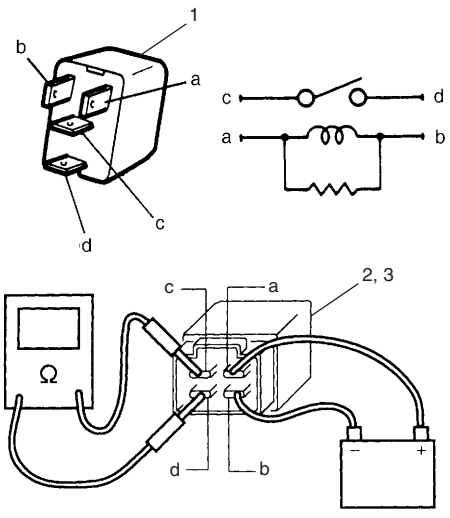


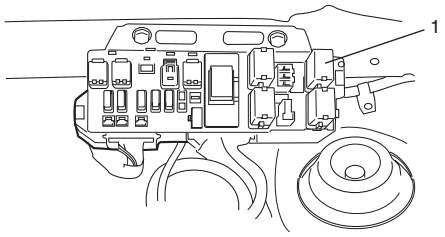
[B]

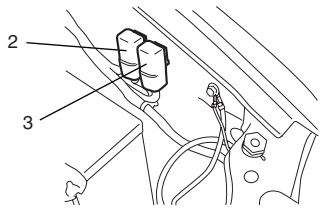


[A]: Fig. 1 for Step 1
[B]: Fig. 2 for Step 4

[A]







[A]: Fig. 2 for Step 3
1. Radiator fan No.1
2. Radiator fan No.2
3. Radiator fan No.3

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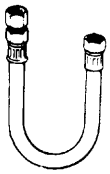
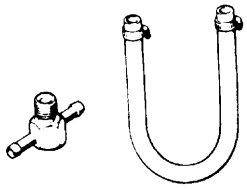
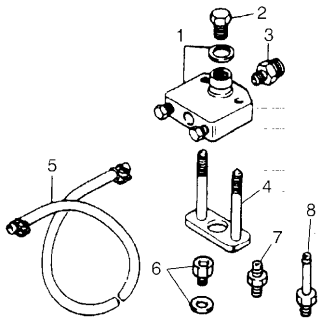
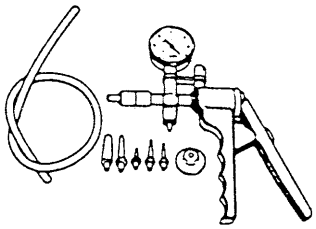
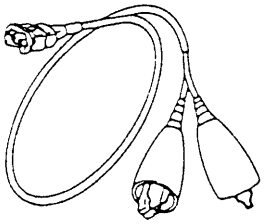
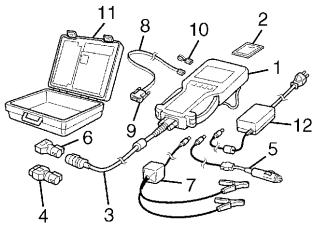
Special Tool

 09912-58441 Pressure gauge	 09912-58431 Pressure hose	 09912-58490 3-way joint & hose	 09912-58421 Checking tool set (See NOTE “A”.)
 09912-57610 Checking tool plate	 09917-47010 Vacuum pump gauge	 09930-88530 Injector test lead	 Tech 2 kit (SUZUKI scan tool) (See NOTE “B”)

NOTE:

- **“A”: This kit includes the following items.**
  1. Tool body & washer, 2. Body plug, 3. Body attachment, 4. Holder, 5. Return hose & clamp, 6. Body attachment-2 & washer, 7. Hose attachment-1, 8. Hose attachment-2
- **“B”: This kit includes the following items.**
  1. Tech 2, 2. PCMCIA card, 3. DLC cable, 4. SAE 16/19 adapter, 5. Cigarette cable, 6. DLC loopback adapter, 7. Battery power cable, 8. RS232 cable, 9. RS232 adapter, 10. RS232 loopback connector, 11. Storage case, 12. Power supply

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SECTION 6A1

ENGINE MECHANICAL (M13 ENGINE)

WARNING:

For vehicles equipped with Supplemental Restraint (Air Bag) System:

- **Service on and around the air bag system components or wiring must be performed only by an authorized SUZUKI dealer. Refer to "Air Bag System Components and Wiring Location View" under "General Description" in air bag system section in order to confirm whether you are performing service on or near the air bag system components or wiring. Please observe all WARNINGS and "Service Precautions" under "On-Vehicle Service" in air bag system section before performing service on or around the air bag system components or wiring. Failure to follow WARNINGS could result in unintentional activation of the system or could render the system inoperative. Either of these two conditions may result in severe injury.**
- **Technical service work must be started at least 90 seconds after the ignition switch is turned to the "LOCK" position and the negative cable is disconnected from the battery. Otherwise, the system may be activated by reserve energy in the Sensing and Diagnostic Module (SDM).**

NOTE:

For the item with asterisk (*) in the "CONTENTS" below, refer to the same section of the Service Manual mentioned in "FOREWORD" of this manual.

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- Engine Lubrication 6A1-*

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- Diagnosis Table 6A1-*
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- Engine Vacuum Check 6A1-*
- Oil Pressure Check 6A1-*
- Valve Lash (Clearance) 6A1-*

On-Vehicle Service 6A1-2
- Air Cleaner Element 6A1-*
- Air Cleaner Assembly and Resonator 6A1-*
- Knock Sensor 6A1-*
- Cylinder Head Cover 6A1-*
- Throttle Body and Intake Manifold 6A1-*
- Exhaust Manifold 6A1-*
- Oil Pan and Oil Pump Strainer 6A1-*
- Timing Chain Cover 6A1-*
- Oil Pump 6A1-*
- Timing Chain and Chain Tensioner 6A1-2
- Camshaft, Tappet and Shim 6A1-*
- Valves and Cylinder Head 6A1-*
- Pistons, Piston Rings, Connecting Rods and Cylinders 6A1-*
- Engine Mountings 6A1-*

Unit Repair Overhaul 6A1-*
- Engine Assembly 6A1-*
- Main Bearings, Crankshaft and Cylinder Block 6A1-*

Required Service Material 6A1-*

Tightening Torque Specification 6A1-7

Special Tool 6A1-*

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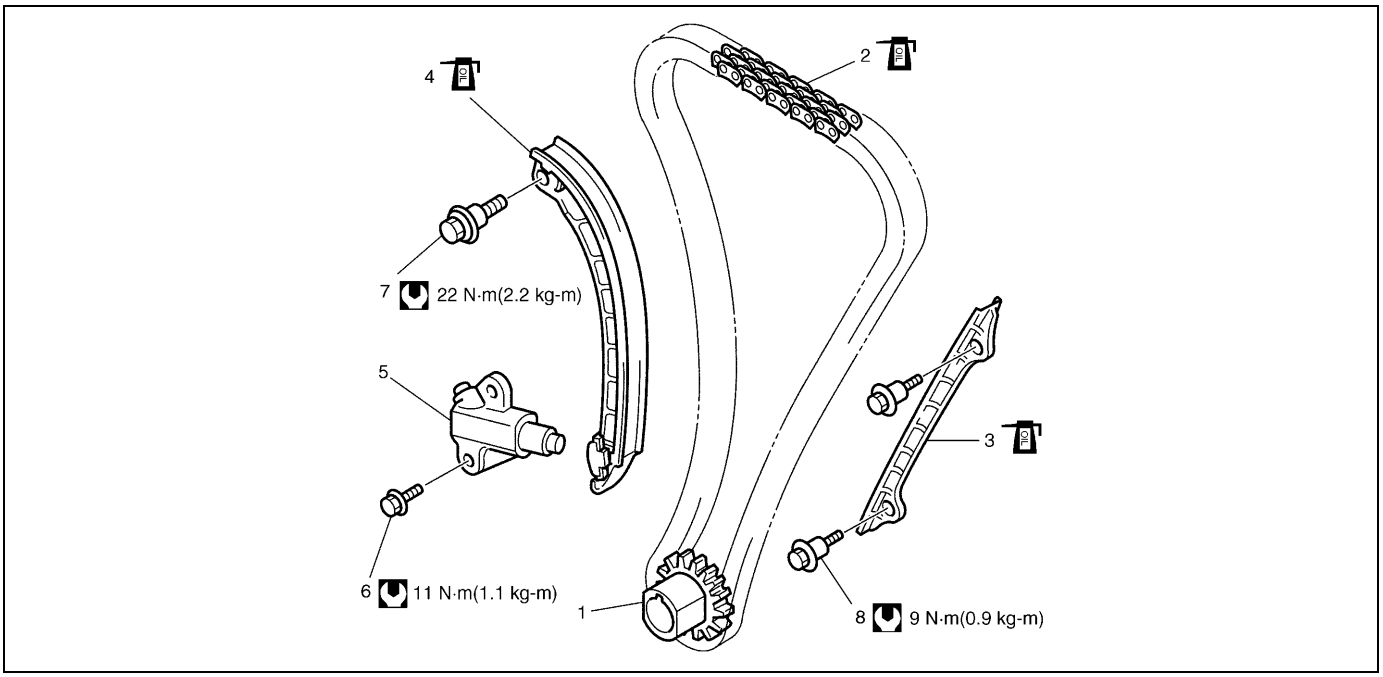
On-Vehicle Service

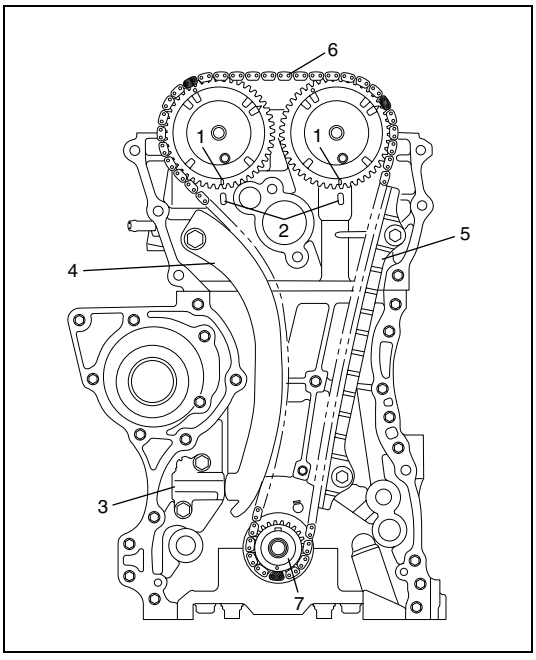
Timing Chain and Chain Tensioner



	1. Crankshaft timing sprocket	5. Timing chain tensioner adjuster assembly	Tightening torque
●	2. Timing chain : Apply engine oil to sliding surface.	6. Chain tensioner adjuster mounting bolt	
●	3. Timing chain No.1 guide : Apply engine oil to sliding surface.	7. Chain tensioner mounting bolt	
●	4. Timing chain tensioner : Apply engine oil to sliding surface.	8. Chain guide mounting bolt	

Removal

1) Remove timing chain cover referring to “Timing Chain Cover”.



2) Align both intake and exhaust camshaft timing sprocket marks (1) with notches (2) of cylinder head respectively by turning crankshaft.
3) Remove timing chain tensioner adjuster assembly (3).
4) Remove timing chain tensioner (4).
5) Remove timing chain No.1 guide (5).
6) Remove timing chain (6) with crankshaft timing sprocket (7).

CAUTION:

After timing chain is removed, never turn crankshaft and camshafts independently more than its allowable turning range described in “Installation” section.

If turned, interference may occur between piston and valves and valves themselves, and parts related to piston and valves may be damaged.

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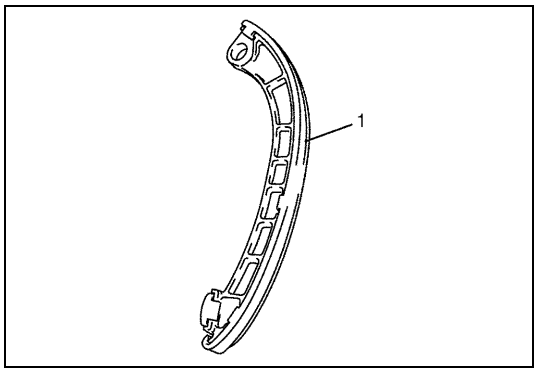
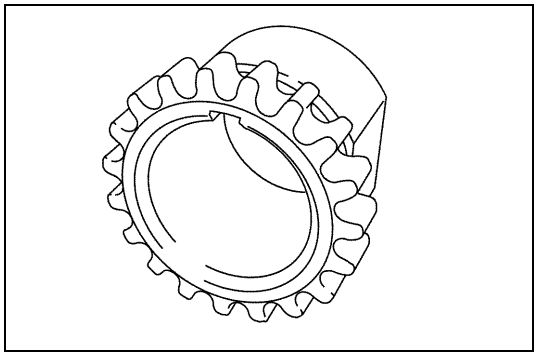
Inspection



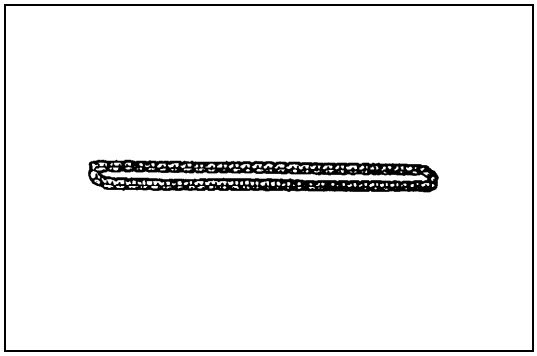
Timing chain tensioner

- Check shoe (1) for wear or damage.



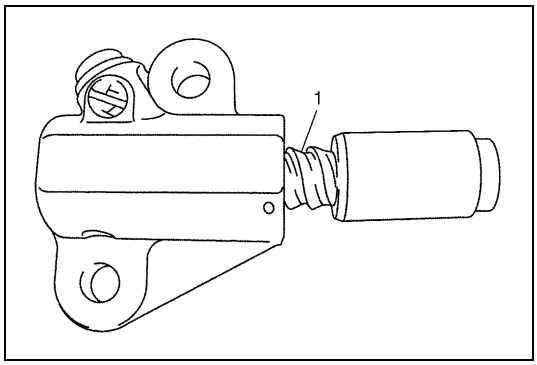
Crankshaft timing sprocket

- Check teeth of sprocket for wear or damage.



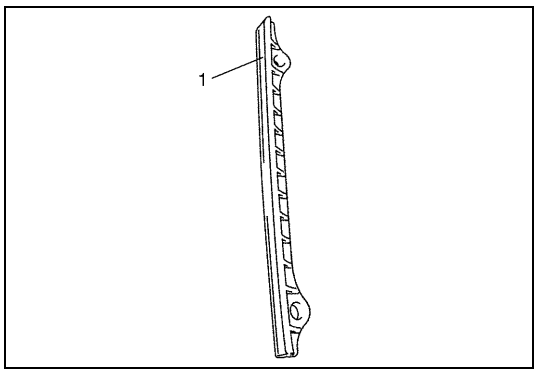
Timing chain

- Check timing chain for wear or damage.



Timing chain tensioner adjuster

- Check that tooth surface (1) are free from damage.



Timing chain No.1 guide

- Check shoe (1) for wear or damage.

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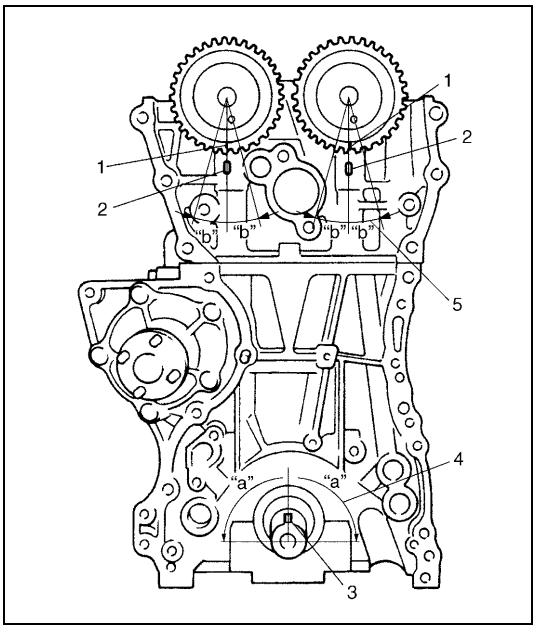
Installation



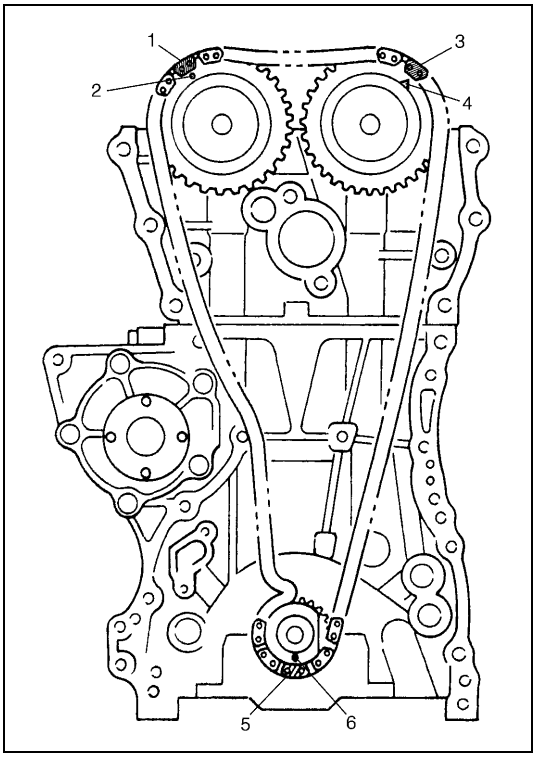
CAUTION:

After timing chain is removed, never turn crankshaft and camshafts independently more than such an extent ("a", "b") as shown in figure.

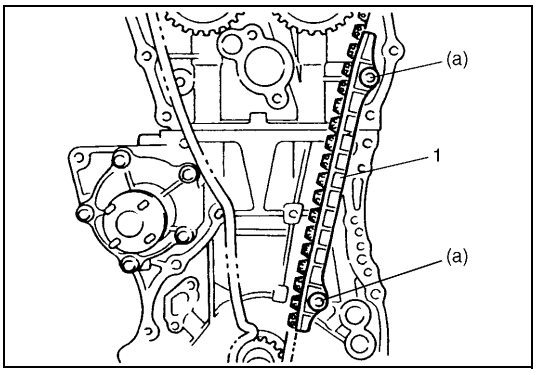
If turned, interference may occur between piston and valves and valves themselves, and parts related to piston and valves may be damaged.

1) Check that match marks (1) on intake and exhaust camshaft timing sprockets are in match with notches (2) on cylinder head as shown in figure.
2) Set key (3) and turn crankshaft to position key on upside of crankshaft.

"a" : 90°	4. Crankshaft allowable turning range. By key on crankshaft, within 90° from top on both right and left.
"b" : 15°	5. Camshaft (IN and EX) allowable turning range. By marks on camshaft timing sprocket within 15° from notches on cylinder head on both right and left.



3) Install timing chain by aligning dark blue plate (1) of timing chain and mark (2) on camshaft timing sprocket and then aligning dark blue plate (3) and triangle mark (4) as shown in figure.
4) Fit crankshaft timing sprocket to timing chain by aligning gold plate (5) of timing chain and mark (6) on crankshaft timing sprocket. Then install crankshaft timing sprocket fitted with chain to crankshaft.



5) Apply engine oil to sliding surface of timing chain No.1 guide (1) and install it as shown in figure.
   Tighten guide bolts to specified torque.

Tightening torque
Timing chain No.1 guide bolts
(a): 9 N·m (0.9 kg-m, 6.5 lb-ft)

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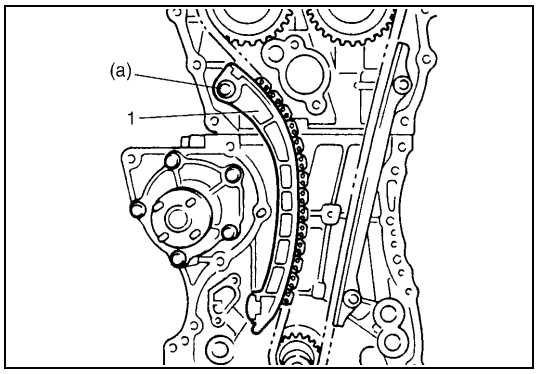
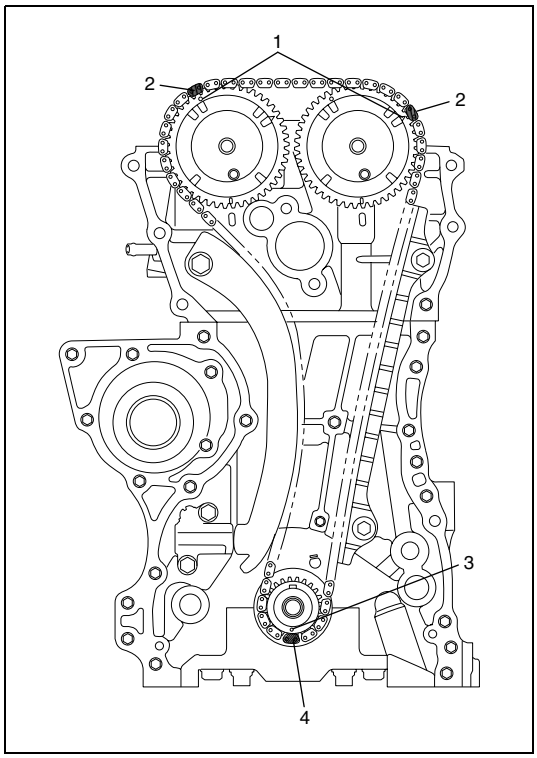
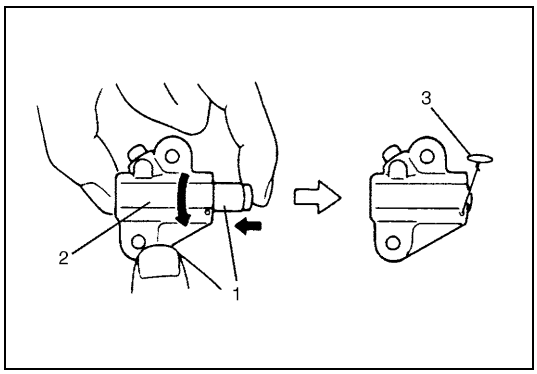


6) Apply engine oil to sliding surface of chain tensioner (1) and install chain tensioner and spacer.
Tighten tensioner bolt to specified torque

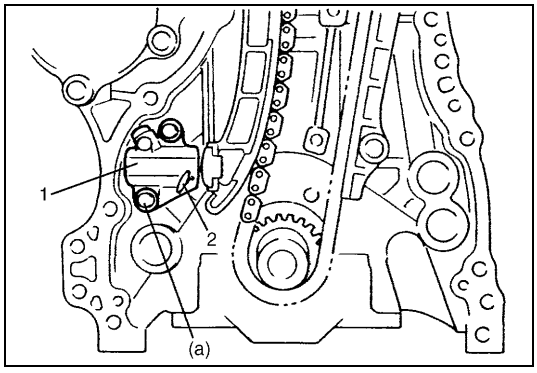
Tightening torque
Timing chain tensioner bolt
(a): 22 N·m (2.2 kg-m, 16.0 lb-ft)



7) Check that match marks (1) on intake and exhaust camshaft timing sprockets are in match with dark blue plates (2) of timing chain and match mark (3) on crankshaft timing sprocket is in match with gold plate (4) of timing chain.



8) Screw in plunger (1) by turning timing chain tensioner adjuster (2) in arrow direction and install a retainer (3) (wire) to hold plunger in place.



9) Install timing chain tensioner adjuster assembly (1) with a retainer (2).
Tighten adjuster bolts to specified torque and then remove a retainer from chain tensioner adjuster assembly.

Tightening torque
Timing chain tensioner adjuster bolts
(a): 11 N·m (1.1 kg-m, 8.0 lb-ft)

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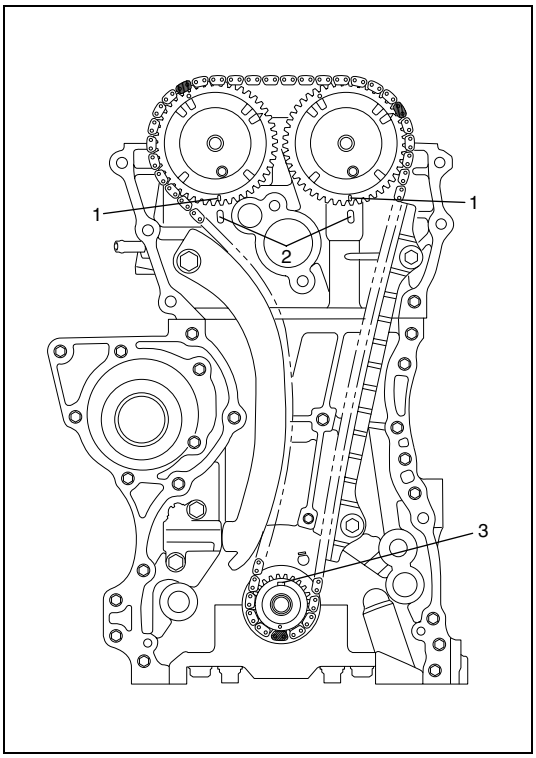

10) Apply engine oil to timing chain and then turn crankshaft clockwise by 2 revolutions and check that match marks (1) on intake and exhaust camshaft timing sprockets are in match with notches (2) on cylinder head and key (3) is on upside of crankshaft as shown in figure.
    If each mark of timing chain and each match mark are no matches, adjust each sprocket and timing chain.
11) Install timing chain cover referring to “Timing Chain Cover” in this section.
12) Perform Steps 3) to 8) of “Installation” of “Timing Chain Cover” in this section.

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Tightening Torque Specification

Fastening part	Tightening torque		
	N•m	kg-m	lb-ft
Oil pressure switch	14.0	1.4	10.5
Camshaft housing bolts (for replacement of shim)	8.0	0.8	6.0
Camshaft housing bolts	11.0	1.1	8.0
Cylinder head cover bolts	8.0	0.8	6.0
Intake manifold bolts and nuts	25.0	2.5	18.0
Exhaust manifold bolts and nuts	50.0	5.0	36.5
Exhaust No.1 pipe bolts	50.0	5.0	36.5
Exhaust manifold stiffener bolts	50.0	5.5	36.5
Oil pump strainer bolt	11.0	1.1	8.0
Oil pump strainer bracket bolt	11.0	1.1	8.0
Oil pan bolts and nuts	11.0	1.1	8.0
Oil pan drain plug bolt	50.0	5.0	36.5
Timing chain cover bolts	23.0	2.3	17.0
Engine mounting bolts	75.0	7.5	54.5
Engine mounting bracket bolts	55.0	5.5	40.0
Crank shaft pulley bolt	150.0	15.0	108.5
Oil pump rotor plate bolts	11.0	1.1	8.0
Timing chain No.1 guide bolts	9.0	0.9	6.5
Timing chain tensioner adjuster bolt	11.0	1.1	8.0
Venturi plug	5.0	0.5	3.5
Cylinder head bolts for M8	22.0	2.2	16.0
Cylinder head bolts for M10	a) Tighten 40 N·m b) Turn 60° c) Turn 60°	a) Tighten 4.0 kg-m b) Turn 60° c) Turn 60°	a) Tighten 29.0 lb-ft b) Turn 60° c) Turn 60°
Connecting rod bearing cap nuts	a) Tighten 15 N·m b) Turn 45° c) Turn 45°	a) Tighten 1.5 kg-m b) Turn 45° c) Turn 45°	a) Tighten 11.0 lb-ft b) Turn 45° c) Turn 45°
Engine mounting bolts and nuts for M10	55.0	5.5	40.0
Engine mounting bolts and nuts for M12	75.0	7.5	54.5
Crankshaft bearing cap No.1 bolts (for inspection of crankshaft thrust play)	50.0	5.0	36.5
Crankshaft bearing cap No.2 bolts	22.0	2.2	16.0
Sensor plate bolts	11.0	1.1	8.0
Crankshaft bearing cap No.1 bolts	a) Tighten 50 N·m b) Turn 60°	a) Tighten 5.0 kg-m b) Turn 60°	a) Tighten 36.5 lb-ft b) Turn 60°
Rear oil seal housing bolts	11.0	1.1	8.0
Flywheel or drive plate bolts	70.0	7.0	51.0

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SECTION 6A2

ENGINE MECHANICAL (M15 ENGINE)

WARNING:

For vehicles equipped with a Supplemental Restraint (Air Bag) System:

- **Service on and around the air bag system components or wiring must be performed only by an authorized SUZUKI dealer. Refer to "Air Bag System Components and Wiring Location View" under "General Description" in air bag system section in order to confirm whether you are performing service on or near the air bag system components or wiring. Please observe all WARNINGS and "Service Precautions" under "On-Vehicle Service" in air bag system section before performing service on or around the air bag system components or wiring. Failure to follow WARNINGS could result in unintentional activation of the system or could render the system inoperative. Either of these two conditions may result in severe injury.**
- **Technical service work must be started at least 90 seconds after the ignition switch is turned to the "LOCK" position and the negative cable is disconnected from the battery. Otherwise, the system may be activated by reserve energy in the Sensing and Diagnostic Module (SDM).**

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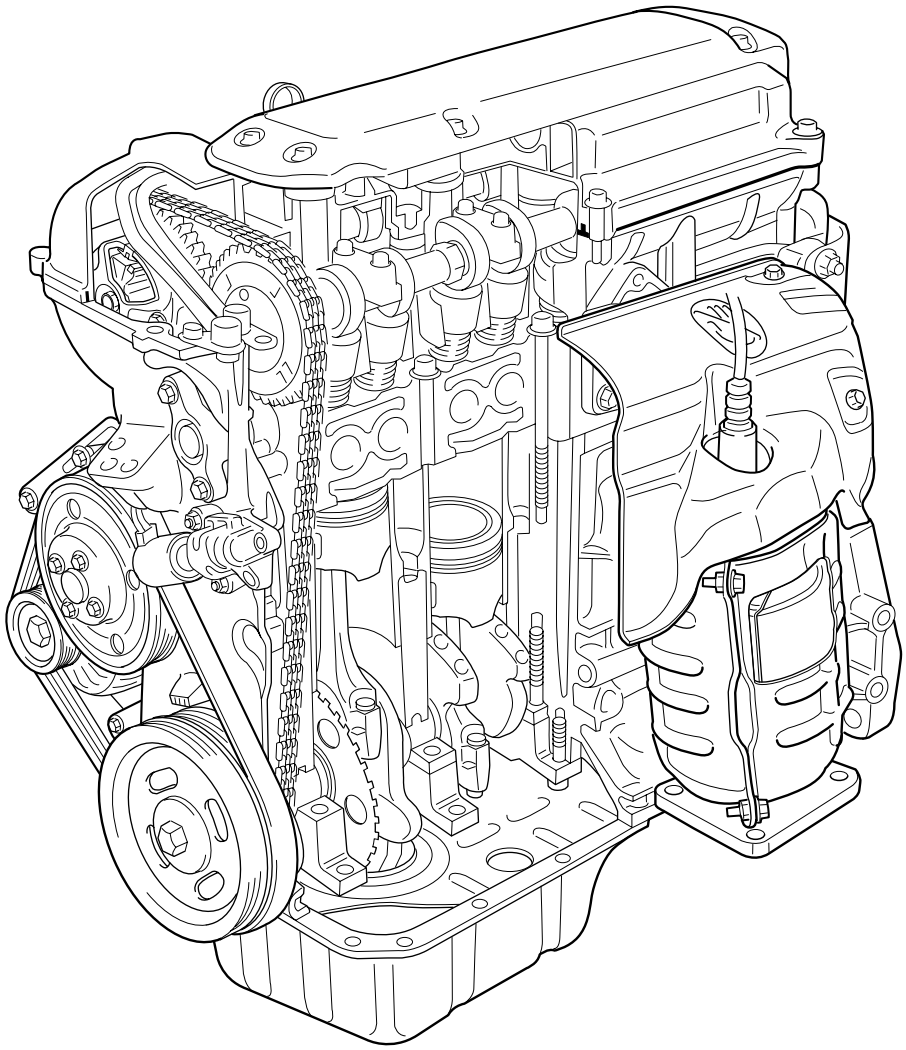
General Description

Engine Construction Description

The engine is water-cooled, in line 4 cylinders, 4 stroke cycle gasoline unit with its DOHC (Double overhead camshaft) valve mechanism arranged for “V” type valve configuration and 16 valves (4 valves/one cylinder). The double overhead camshaft is mounted over the cylinder head; it is driven from crankshaft through timing chain, and no push rods are provided in the valve train system.



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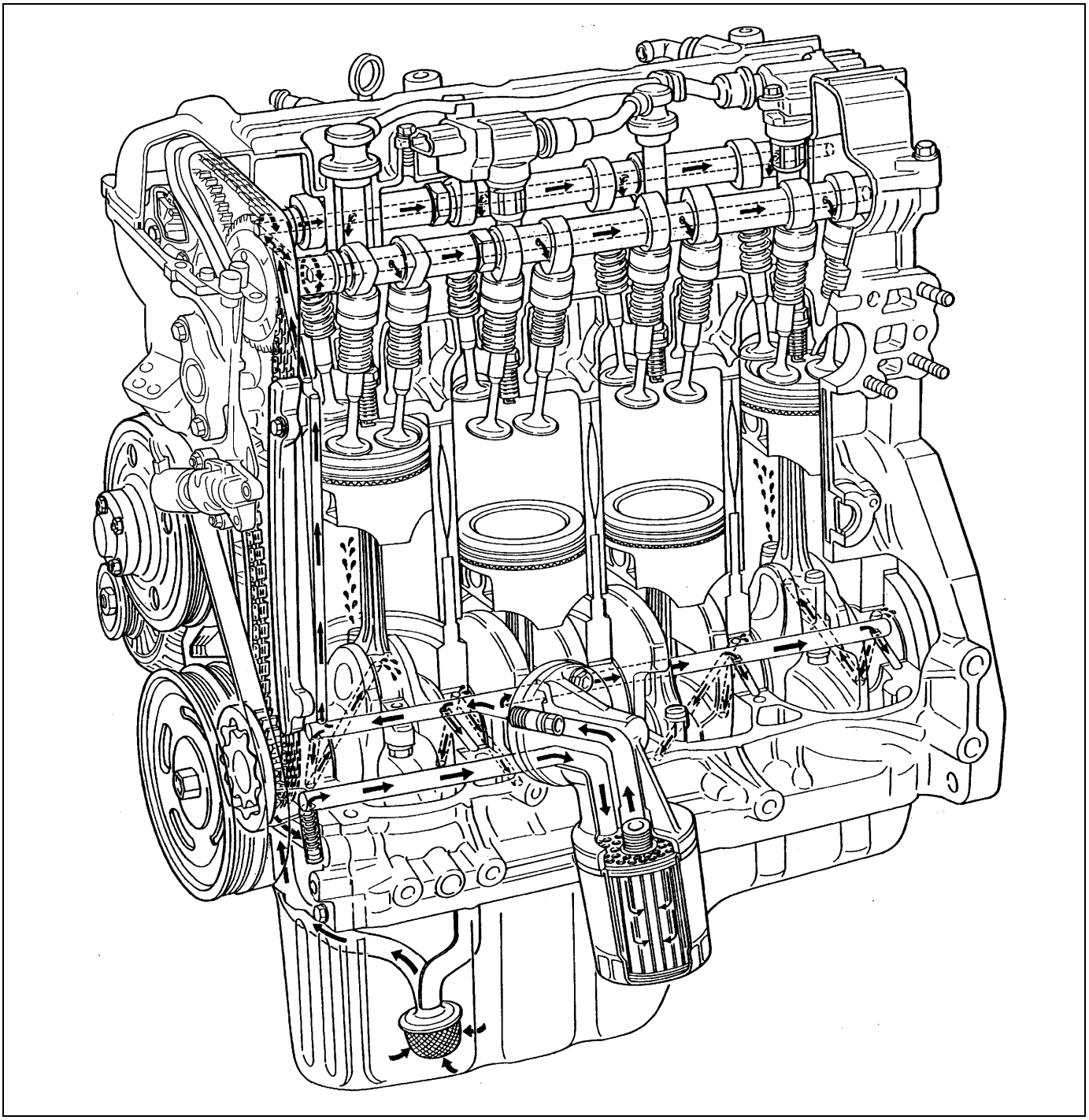
Engine Lubrication Description

The oil pump is of a trochoid type, and mounted on the crankshaft. Oil is drawn up through the oil pump strainer and passed through the pump to the oil filter.
The filtered oil flows into 2 paths in cylinder block.
In one path, oil reaches the crankshaft journal bearings. Oil from the crankshaft journal bearings is supplied to the connecting rod bearings by means of intersecting passages drilled in the crankshaft, and then injected from the big end of connecting rod to lubricate piston, rings, and cylinder wall.
In other path oil goes up to the cylinder head and lubricates valves and camshafts, etc., after passing through the internal oilway of camshafts.

An oil relief valve is provided on the oil pump. This valve starts relieving oil pressure when the pressure exceeds about 390 kPa (3.9 kg/cm^2, 56.6 psi).



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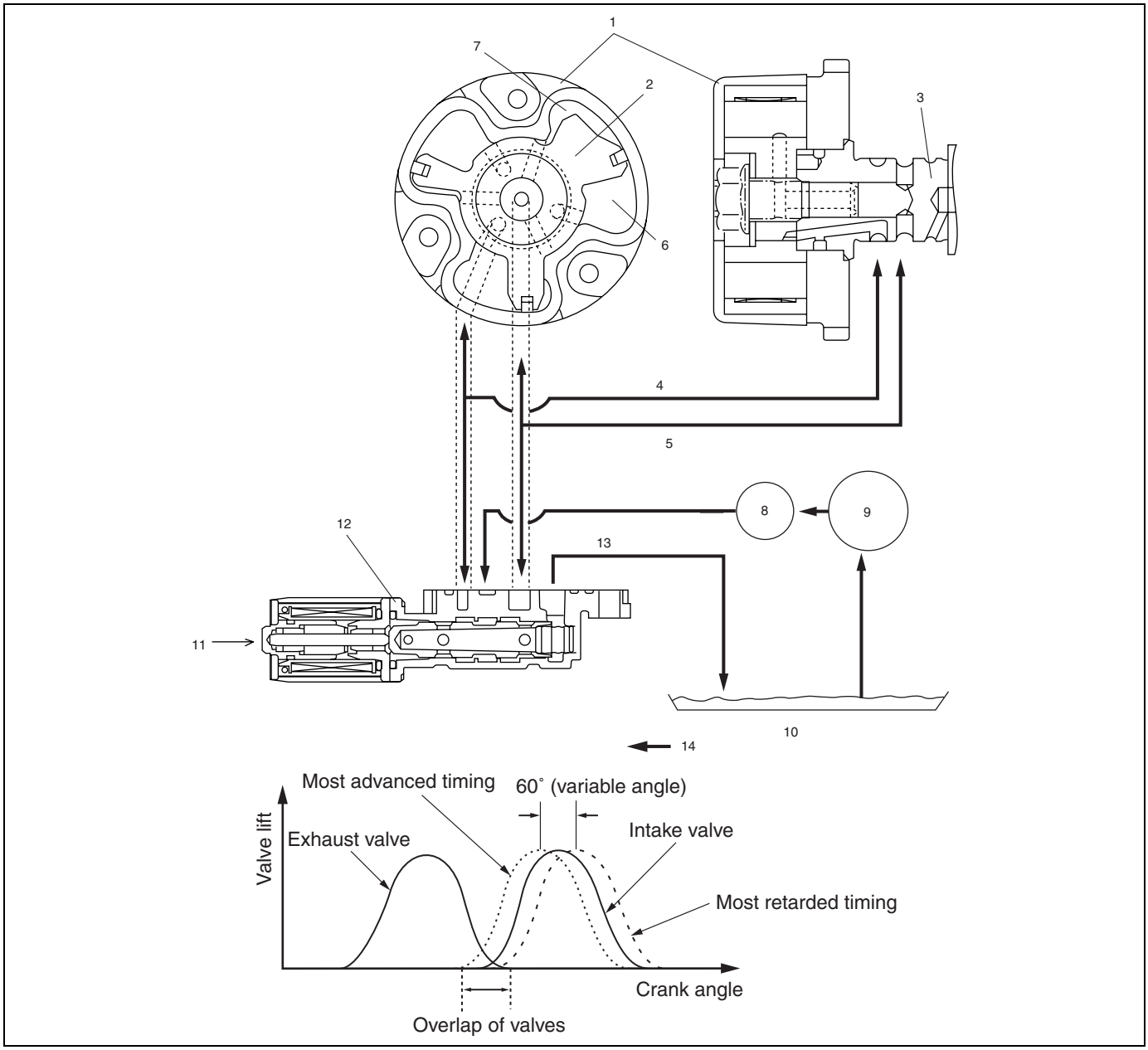
Variable Valve Timing (VVT) System Description

System description

The VVT system is an electronic control system which continuously vary and optimize the intake valve timing in response to the engine operating condition.

The optimized intake valve timing produce such an air intake with high efficiency that both the higher power generation and lower fuel consumption can be attained in the whole engine speed range from low to high. In the area of the average engine load, low emission of nitrogen oxides (NOx) and high fuel efficiency can also be attained by making the valve opening overlap between the intake and exhaust valves longer.

For the brief of the system operation, the intake valve timing is varied by the cam timing sprocket (1) which varies the rotational phase between the intake camshaft (3) and sprocket. The rotor (2) in the cam timing sprocket is actuated by switching or adjusting the hydraulic pressure applied to the chambers for the timing advancing (7) and/or retarding (6). To switch or adjust the hydraulic pressure appropriately, ECM operates the oil control valve (12) with detecting the engine speed, intake air value, throttle opening, engine coolant temperature and camshaft position (angle).



4. Oil passage to chamber for timing retarding	8. Oil filter	10. Oil pan	13. Oil return
5. Oil passage to chamber for timing advancing	9. Oil pump	11. Control signal from ECM	14. Oil flow

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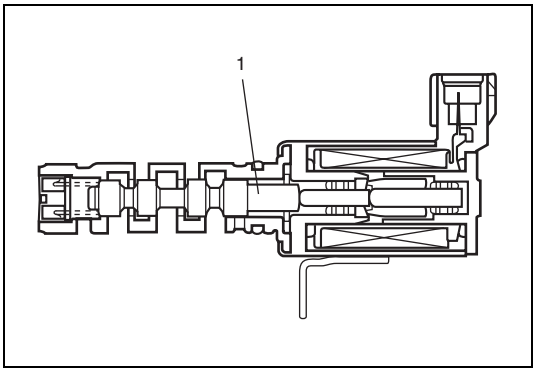
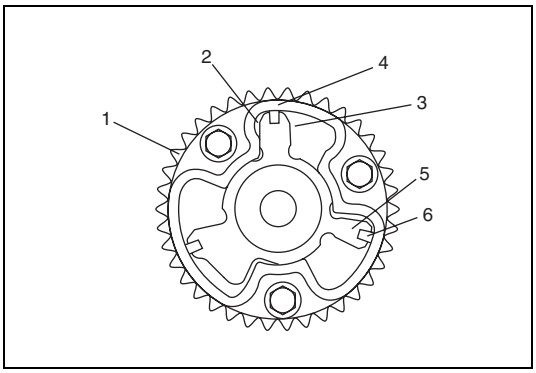


Oil control valve

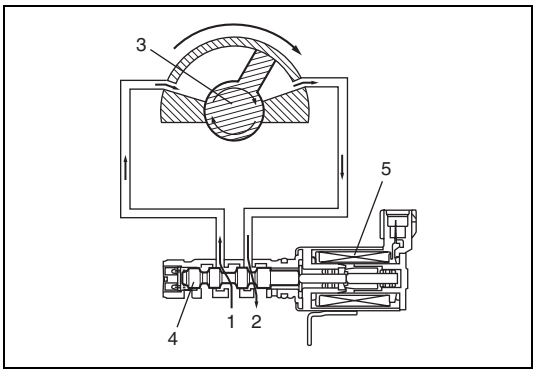
The oil control valve switches and adjusts the hydraulic pressure applied to the cam timing sprocket by moving the spool valve (1) according to the duty pulse signals output from the ECM. By this operation, the intake valve timing is varied continuously. Signals output from the ECM are the duty pulse of about 240 Hz.



Cam timing sprocket

The cam timing sprocket is equipped with the chambers for timing advancing (2) and retarding (3) which are separated by the rotor (5). The rotor rotates receiving the hydraulic pressure applied to both the chambers. The sprocket (1) is installed on the housing (4) and the rotor is secured on the intake camshaft by fastening the bolts. Therefore, the actuation of the rotor makes the phase difference between the sprocket and intake camshaft.

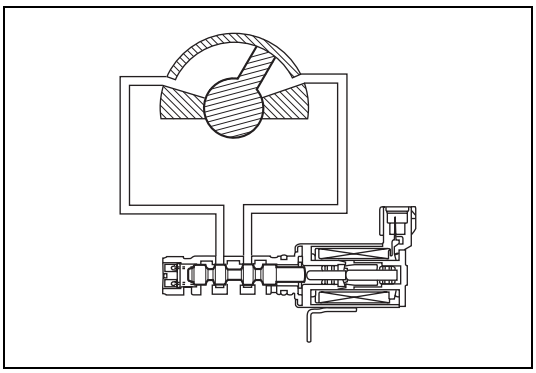
6. Seal



Timing advancing

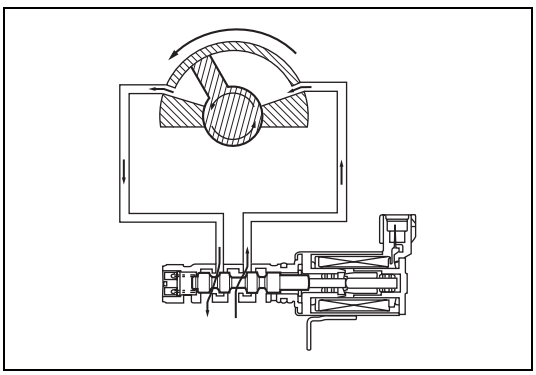
When the duty ratio of the signal output from the ECM is heavy, the spool valve (4) of the oil control valve moves to the left (opposite direction against the coil (5)). By this spool valve movement, the pressurized oil (1) is led into the chambers for timing advancing and the oil in the chambers for timing retarding is drained. This operations actuate the rotor (3) and result in the advanced timing of the intake valve.

2. Drain



Timing holding

When the duty ratio of the signal output from the ECM shows that of holding, the spool valve of the oil control valve is located at hold position. Because this condition generates no oil pressure changes in both chambers, the rotor is fixed at a target position.



Timing retarding

When the duty ratio of the signal output from the ECM is light, the spool valve of the oil control valve moves to the right (head for the coil). By this spool valve movement, the pressurized oil is led into the chambers for timing retarding and the oil in the chambers for timing advancing is drained. This operations actuate the rotor and result in the retarded timing of the intake valve.

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Targeted timing varying operation

DRIVING CONDITION	VALVE TIMING	TARGET OF CONTROL	EFFECT
Engine running at idle speed	Most retarded	To shorten the valve opening overlap in order to prevent the exhaust gas counterflow to intake manifold.	Stabilization of the engine rotation at idle speed.
Average engine load range	To the advanced side	To lengthen the valve opening overlap in order to enhance the internal exhaust gas recirculation and reduce the pumping loss.	Improvement of the fuel efficiency. Lowering of the exhaust emission.
Light engine load range	To the retarded side	To shorten the valve opening overlap in order to prevent the exhaust gas counterflow to intake manifold.	Keeping of the engine stability.
Low or average engine speed range with heavy engine load	To the advanced side	To advance the closing timing of the intake valve in order to improve the volumetric efficiency.	Improvement of generating the engine torque at low and average engine speed.
High engine speed range with heavy engine load	To the retarded side	To retard the closing timing of the intake valve in order to improve the volumetric efficiency.	Improvement of generating the engine power.
Low engine coolant temperature	Most retarded	To shorten the valve opening overlap in order to prevent the exhaust gas counterflow to intake manifold and reduce the fuel increasing. To slow the fast idle speed of the engine as a result of stabilizing the engine idling.	Stabilization of the fast idling of the engine. Improvement of the fuel efficiency.
At engine starting and stopping	Most retarded	To shorten the valve opening overlap in order to prevent the exhaust gas counterflow to intake manifold.	Improvement of start ability

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Diagnosis

Diagnosis Table

Refer to “Engine Diagnosis Table” in Section 6.

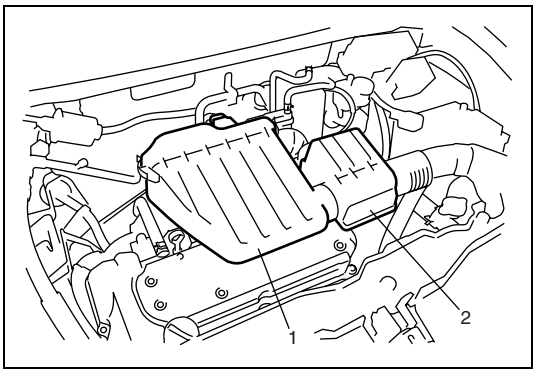
Compression Check

Check compression pressure on all 4 cylinders as follows:

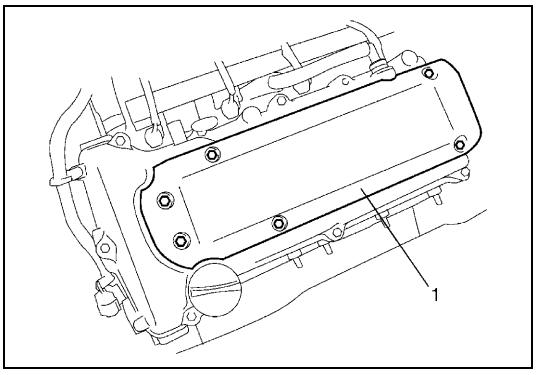
1) Warm up engine to normal operating temperature.
2) Stop engine after warming up.

NOTE:

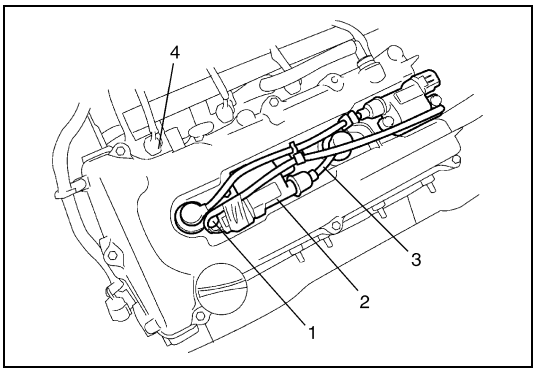
After warming up engine, place transaxle gear shift lever in “Neutral” and set parking brake and block drive wheels.



3) Remove air cleaner case (1) and resonator (2).



4) Remove cylinder head upper cover (1).



5) Disconnect ignition coil couplers (1).
6) Remove ignition coil assemblies (2) with high-tension cord (3).
7) Remove all spark plugs.
8) Disconnect fuel injector wires (4) at the coupler.

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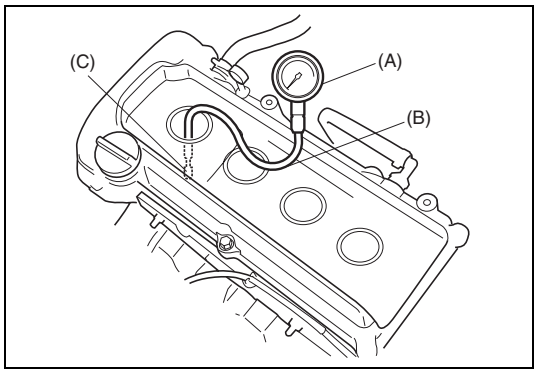
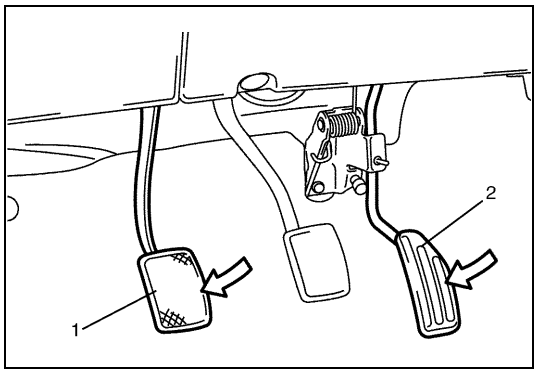


9) Install special tools (compression gauge) into spark plug hole.

Special tool
(A): 09915-64512
(B): 09915-64530
(C): 09915-67010



10) Disengage clutch (1) (to lighten starting load on engine) for M/T vehicle, and depress accelerator pedal (2) all the way to make throttle fully open.

11) Crank engine with fully charged battery, and read the highest pressure on compression gauge.

NOTE:

- **For measuring compression pressure, crank engine at least 250 rpm by using fully charged battery.**
- **If measured compression pressure is lower than limit value, check installation condition of special tool. If it is properly installed, possibility is compression pressure leakage from where piston ring or valve contact.**

Compression pressure

Standard	**1400 kPa (14.0 kg/cm^2, 199.0 psi)**
Limit	**1100 kPa (11.0 kg/cm^2, 156.0 psi)**
Max. difference between any two cylinders	**100 kPa (1.0 kg/cm^2, 14.2 psi)**

12) Carry out Steps 9) through 11) on each cylinder to obtain 4 readings.

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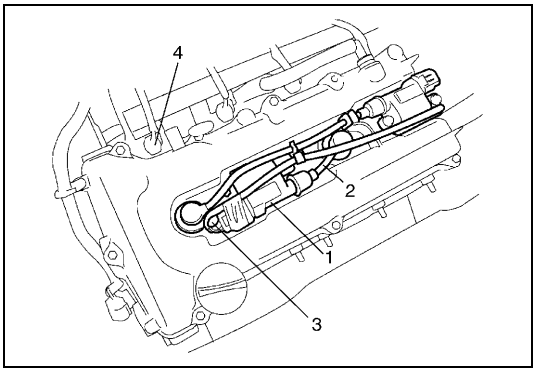


13) After checking, install spark plugs and ignition coil assemblies (1) with high-tension cord (2).
14) Connect ignition coil couplers (3).
15) Connect fuel injector wires(4) at the coupler.
16) Install cylinder head upper cover (1).
17) Install air cleaner assembly and resonator.

Engine Vacuum Check

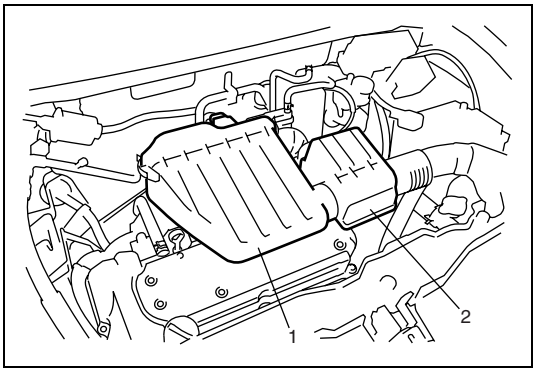
The engine vacuum that develops in the intake line is a good indicator of the condition of the engine. The vacuum checking procedure is as follows:

1) Warm up engine to normal operating temperature.

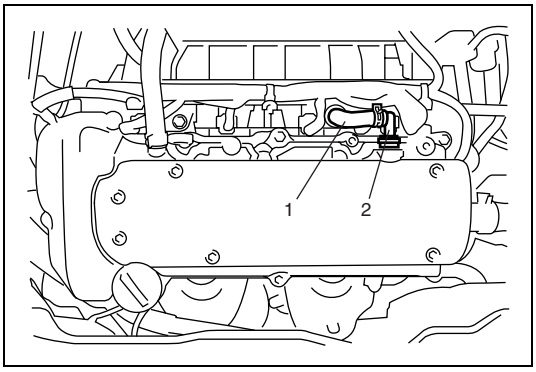
NOTE:

After warming up engine, be sure to place transaxle gear shift lever in "Neutral" and set parking brake and block drive wheels.

2) Stop engine and turn off the all electric switches.



3) Remove air cleaner case (1) and resonator (2).



4) Remove PCV hose (1) from PCV valve (2).

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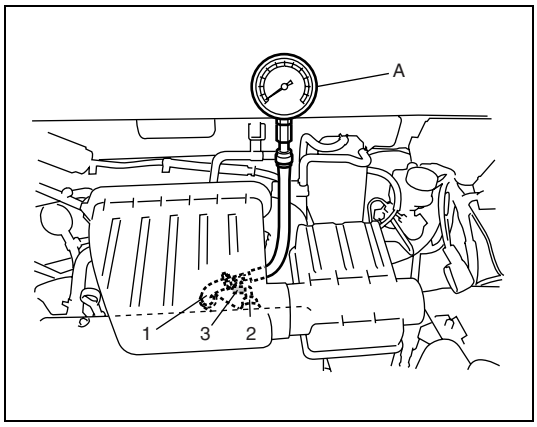

5) Connect special tool (Vacuum gauge) to PCV hose (1).

Special tool
(A): 09915-67311

6) Blind PCV valve (2) using tape (3) or the like.
7) Install air cleaner case and resonator.
8) Run engine at specified idle speed and read vacuum gauge. Vacuum should be within specification.

Vacuum specification (at sea level)
59 – 73 kPa (45 – 55 cmHg, 17.7 – 21.6 inHg)
at specified idle speed

9) After checking, disconnect special tool (Vacuum gauge) from PCV valve.
10) Detach blind cap from PCV valve.
11) Install air cleaner case and resonator.

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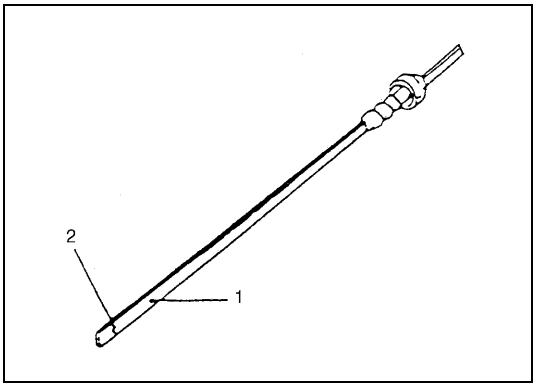
Oil Pressure Check

NOTE:

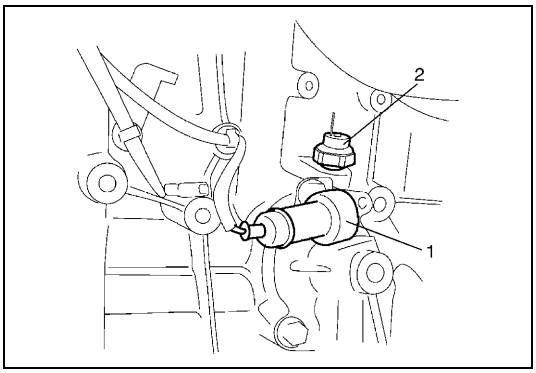
Prior to checking oil pressure, check the following items.



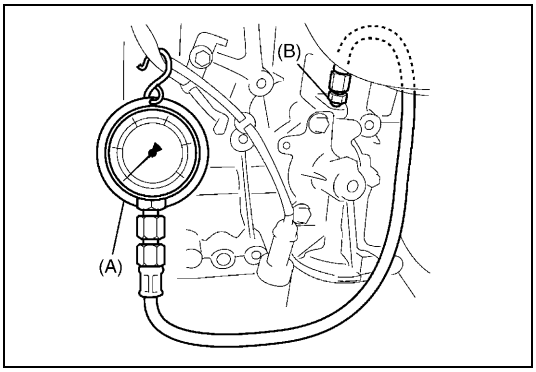
- Oil level in oil pan
  If oil level is low, add oil up to Full level mark (hole) on oil level gauge.
- Oil quality
  If oil is discolored or deteriorated, change it.
  For particular oil to be used, refer to “Engine Oil and Filter Replacement” in Section 0B.

1.	Full level mark (hole)
2.	Low level mark (hole)

- Oil leaks
  If leak is found, repair it.



1) Disconnect oil pressure switch coupler (1).
2) Remove exhaust manifold cover, if necessary.
3) Remove oil pressure switch (2) from cylinder block.



4) Install special tools (Oil pressure gauge) to threaded hole of oil pressure switch.

Special tool
(A): 09915-77311
(B): 09915-78211

5) Start engine and warm it up to normal operating temperature.

NOTE:

Be sure to place transaxle gear shift lever in “Neutral” and set parking brake and block drive wheels.

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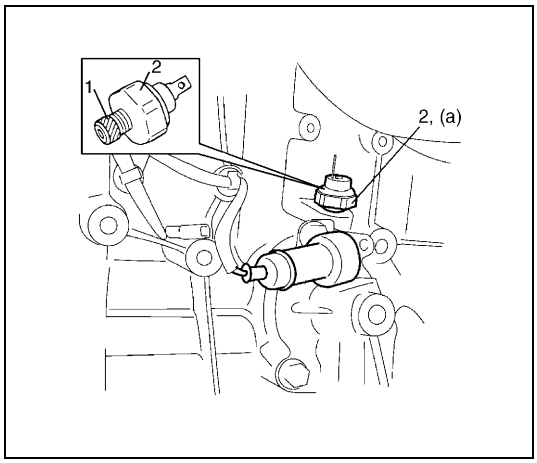
6) After warming up, raise engine speed to 4,000 rpm and measure oil pressure.

Oil pressure specification

More than 270 kPa (2.7 kg/cm^2, 39.8 psi) at 4,000 rpm

7) Stop engine and remove oil pressure gauge and attachment.



8) Before reinstalling oil pressure switch (2), be sure to wrap its screw threads with sealing tape (1) and tighten switch to specified torque.

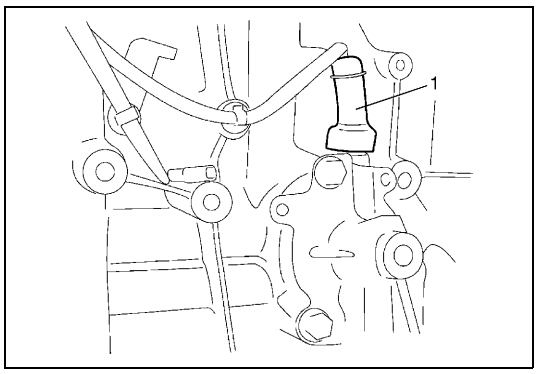
NOTE:

If sealing tape edge is bulged out from screw threads of switch, cut it off.

Tightening torque

Oil pressure switch (a): 14 N·m (1.4 kg-m, 10.5 lb-ft)

9) Start engine and check oil pressure switch (2) for oil leakage. If oil leakage is found, repair it.



10) Connect oil pressure switch coupler and fit cover (1) firmly.

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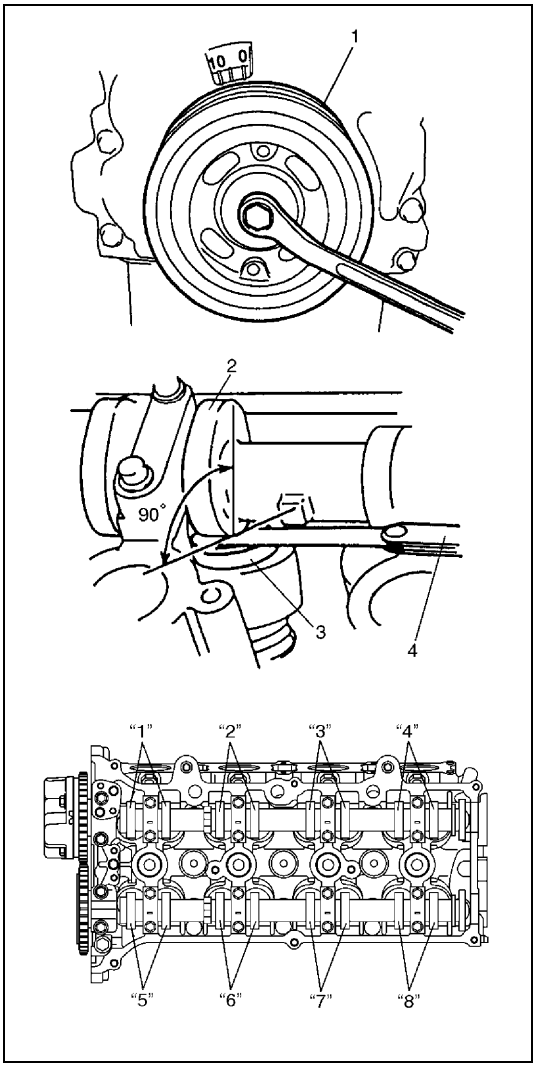
Valve Lash (Clearance) Inspection

1) Remove negative cable at battery.
2) Remove cylinder head cover referring to “Cylinder Head Cover Removal and Installation” in this section.
3) Remove right side engine under cover, if necessary.



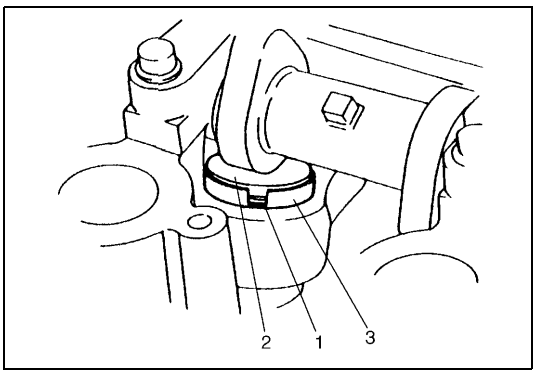
4) Using 17 mm wrench, turn crankshaft pulley (1) clockwise until cam lobes (2) become perpendicular to shim faces (3) at valves “1” and “7” as shown in figure.
5) Check valve lashes with thickness gauge (4) according to the following procedure.
   a) Check valve lashes at valves “1” and “7”.
   b) Turn camshafts by 90° (by turning crankshaft with wrench).
   c) Make sure that cam lobes (2) are perpendicular to shim faces (3) at valves to be checked (in this case, “3” and “8”), if not, adjust it by turning crankshaft. Check valve lashes.
   d) In the same manner as b) – c), check valve lashes at valves “4” and “6”.
   e) In the same manner as b) – c) again, check valve lashes at valves “2” and “5”.

If valve lash is out of specification, record valve lash and adjust it to specification referring to “Shim Replacement” in this section.

Valve clearance specification

	When cold (Coolant temperature is 15 – 25°C (59 – 77°F))	**When hot (Coolant temperature is 60 – 68°C (140 – 154°F))**
Intake	**0.18 – 0.22 mm (0.007 – 0.008 in.)**	**0.21 – 0.27 mm (0.008 – 0.010 in.)**
Exhaust	**0.28 – 0.32 mm (0.011 – 0.012 in.)**	**0.30 – 0.36 mm (0.012 – 0.014 in.)**

Shim Replacement



1) Close the valve whose shim (2) is to be replaced by turning crankshaft, then turn tappet (3) till its cut section (1) faces inside as shown in figure.
2) Lift down the valve by turning crankshaft to 360°.
3) Hold tappet at that position using special tool as follows.
   a) Remove its housing bolts.

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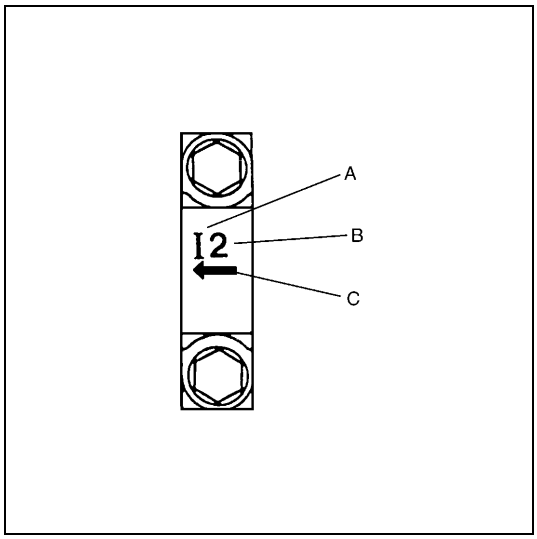
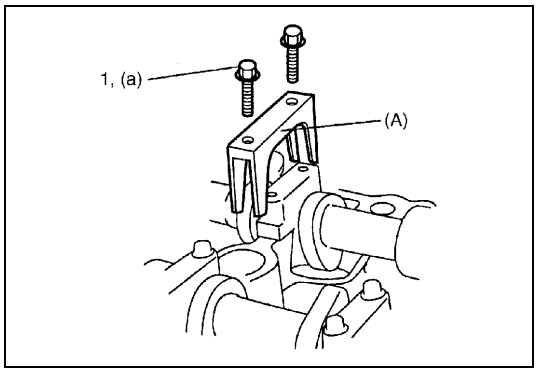


b) Check housing No. and select special tool corresponding to housing No. referring to the following table.

Special tool selection table

No. on camshaft housing	Embossed mark on special tool
I2	IN2
I3, I4, I5	IN345
E2	EX2
E3, E4, E5	EX345

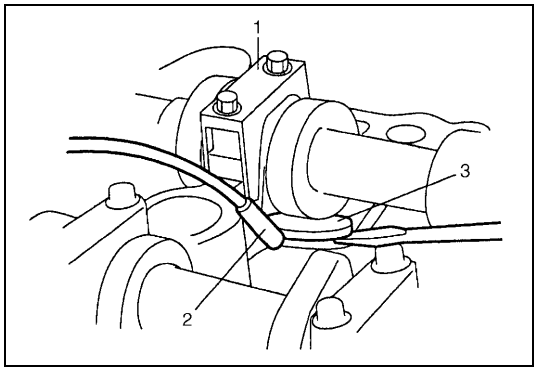
A: I : Intake side or E : Exhaust side
B: Position from timing chain side
C: Pointing to timing chain side



c) Hold down the tappet so as not to contact the shim by installing special tool on camshaft housing with housing bolt (1) tighten housing bolts to specified torque.

Special tool
(A): 09916-67020 or 09916-67021

Tightening torque
Camshaft housing bolts (for tightening of special tool)
(a) : 8 N·m (0.8 kg-m, 6.0 lb-ft)



4) Turn camshaft by approximately 90° clockwise and remove shim (3).

WARNING:
Never put in the hand between cam shaft and tappet.

1. Special tool
2. Magnet

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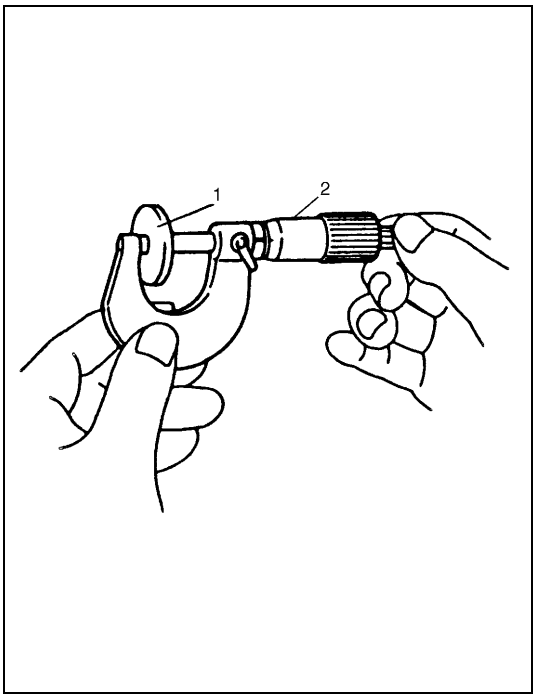
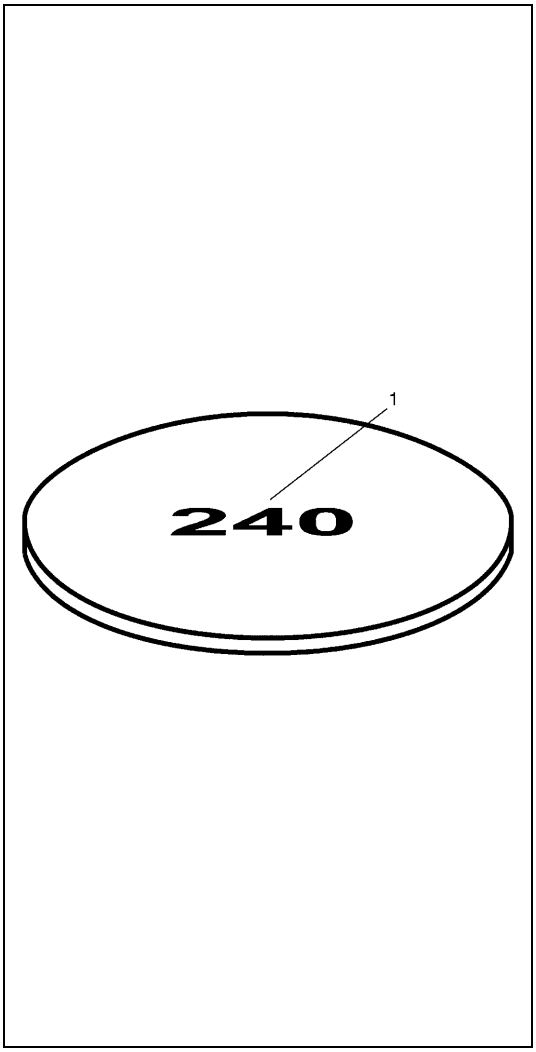


5) Using a micrometer (2), measure the thickness of the removed shim (1), and determine replacement shim by calculating the thickness of new shim with the following formula and table.

Intake side:
A = B + C – 0.20 mm (0.008 in.)
Exhaust side:
A = B + C – 0.30 mm (0.012 in.)

A: Thickness of new shim
B: Thickness of removed shim
C: Measured valve clearance

For example of intake side:
When thickness of removed shim is 2.400 mm (0.0945 in.), and measured valve clearance is 0.450 mm (0.0177 in.).
A = 2.400 mm (0.0945 in.) + 0.450 mm (0.0177 in.) – 0.200 mm (0.0079 in.) = 2.650 mm (0.1043 in.)
Calculated thickness of new shim = 2.650 mm (0.1043 in.)



6) Select new shim No. (1) with a thickness as close as possible to calculated value.

Available new shims No.

Thickness mm (in.)	Shim No.	Thickness mm (in.)	Shim No.
2.175 (0.0856)	218	2.675 (0.1053)	268
2.200 (0.0866)	220	2.700 (0.1063)	270
2.225 (0.0876)	223	2.725 (0.1073)	273
2.250 (0.0886)	225	2.750 (0.1083)	275
2.275 (0.0896)	228	2.775 (0.1093)	278
2.300 (0.0906)	230	2.800 (0.1102)	280
2.325 (0.0915)	233	2.825 (0.1112)	283
2.350 (0.0925)	235	2.850 (0.1122)	285
2.375 (0.0935)	238	2.875 (0.1132)	288
2.400 (0.0945)	240	2.900 (0.1142)	290
2.425 (0.0955)	243	2.925 (0.1152)	293
2.450 (0.0965)	245	2.950 (0.1161)	295
2.475 (0.0974)	248	2.975 (0.1171)	298
2.500 (0.0984)	250	3.000 (0.1181)	300
2.525 (0.0994)	253		
2.550 (0.1004)	255		
2.575 (0.1014)	258		
2.600 (0.1024)	260		
2.625 (0.1033)	263		
2.650 (0.1043)	265		

7) Install new shim facing shim No. side with tappet.

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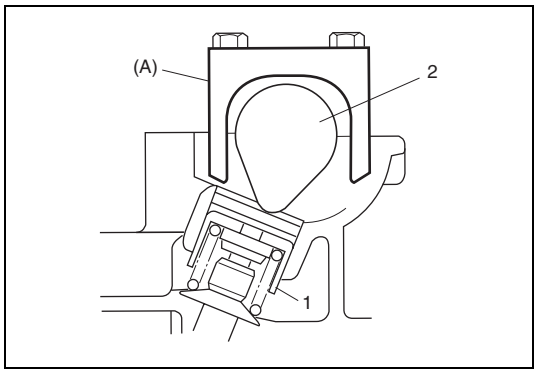
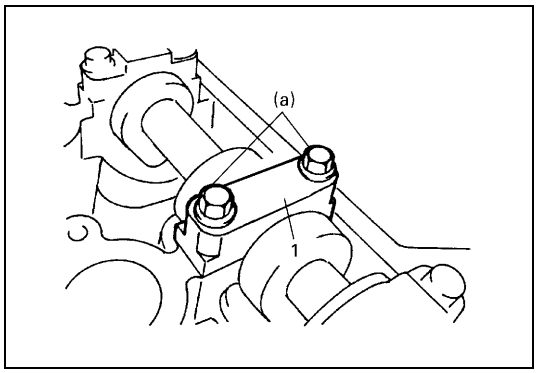


8) Lift valve by turning crankshaft counterclockwise (in opposite direction against above Step 4) and remove special tool.

Special tool
(A): 09916-67020 or 09916-67021

1.	Tappet
2.	Camshaft



9) Install camshaft housing (1) and tighten bolts to specified torque.

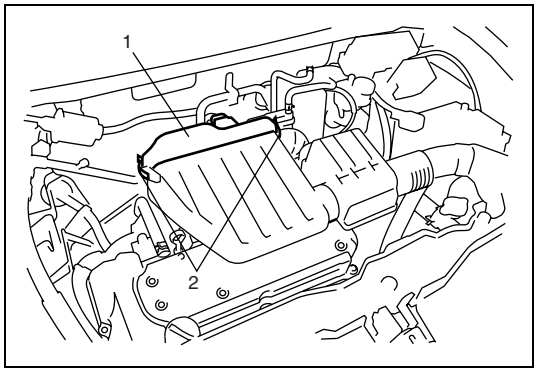
Tightening torque
Camshaft housing bolts (a): 11 N·m (1.1 kg-m, 8.0 lb-ft)

10) Check valve clearance again after adjusting it.
11) After checking and adjusting all valves.
12) Install cylinder head cover referring to “Cylinder Head Cover Removal and Installation” in this section.

On-Vehicle Service

Air Cleaner Element Removal and Installation

Removal



1) Open air cleaner case (1) by unhooking its clamps (2).
2) Remove air cleaner element from case.

Installation

Reverse removal procedure for installation.

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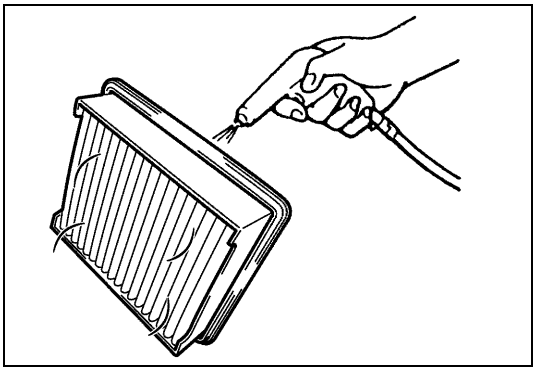
Air Cleaner Element Inspection and Cleaning



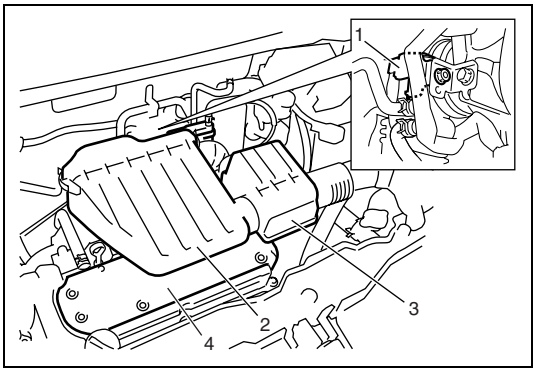
- Check air cleaner element for dirt. Replace excessively dirty element.
- Blow off dust by compressed air from air outlet side of element.

Knock Sensor Removal and Installation

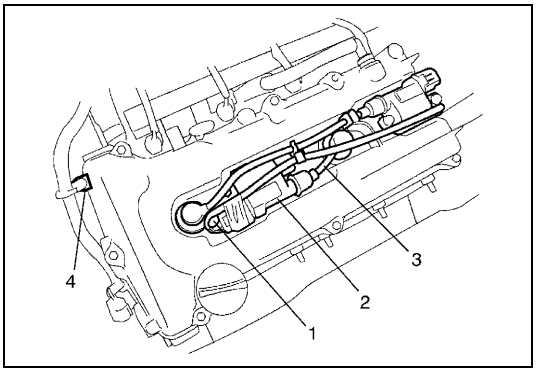
Refer to “Knock Sensor Removal and Installation” in Section 6E2.

Cylinder Head Cover Removal and Installation

Removal



1) Disconnect negative cable at battery.
2) Remove EVAP canister purge valve (1).
3) Remove air cleaner case (2) and resonator (3).
4) Remove cylinder head upper cover (4).



5) Disconnect ignition coil couplers (1).
6) Remove ignition coil assemblies (2) with high-tension cord (3).
7) Remove wire harness clamp (4) from cylinder head cover.

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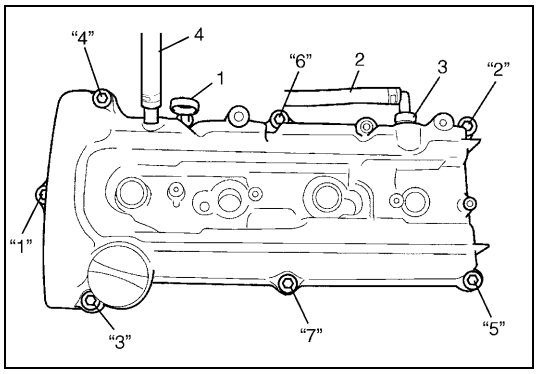
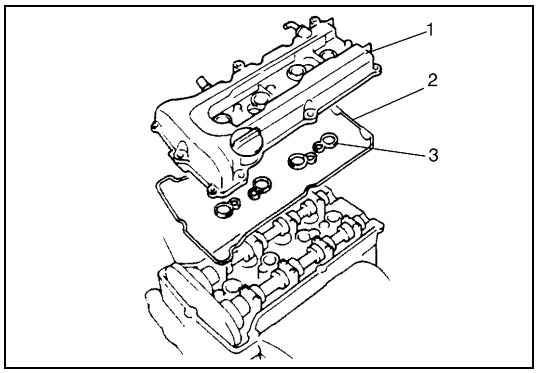
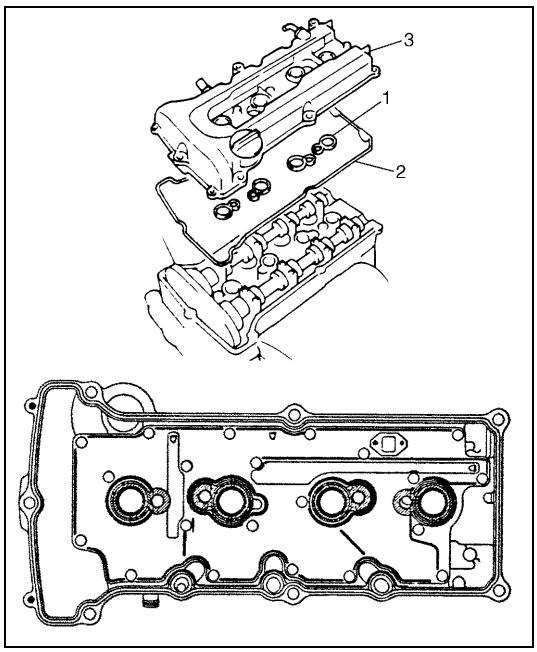


8) Remove oil level gauge (1).
9) Disconnect PCV hose (2) from PCV valve (3) and disconnect breather hose (4) from cylinder head cover.
10) Remove cylinder head cover mounting bolts in such order as indicated in figure.

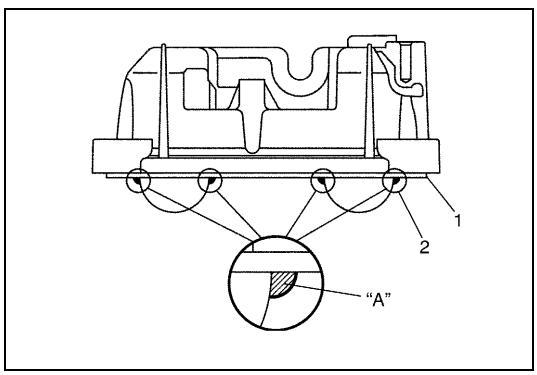


11) Remove cylinder head cover (1) with cylinder head cover gasket (2) and spark plug hole gasket (3).

Installation



1) Install new spark plug hole gaskets (1) and new cylinder head cover gasket (2) to cylinder head cover (3) as shown in figure.



2) Remove oil, old sealant and dust from sealing surface on cylinder head and cover. After cleaning, apply sealant "A" to the following point.
   - Cylinder head cover gasket (1) sealing surface area (2) as shown.

"A": Sealant 99000-31250

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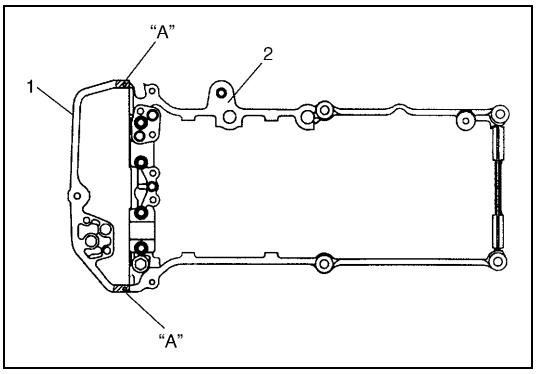


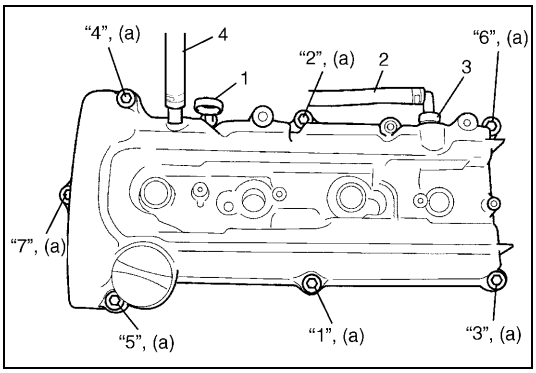
- Timing chain cover (1) and cylinder head (2) mating surface as shown.

"A": Sealant 99000-31250

3) Install cylinder head cover to cylinder head.

NOTE:

When installing cylinder head cover, use care so that cylinder head cover gasket or spark plug hole gaskets will not get out of place or fall off.



4) Tighten bolts in numerical order as indicated in figure a little at a time till they are tightened to specified torque.

Tightening torque
Cylinder head cover bolt
(a): Tighten 8 N·m (0.8 kg-m, 6.0 lb-ft)
by the specified procedure

5) Connect PCV hose (2) to PCV valve (3).
6) Connect breather hose (4).
7) Install oil level gauge (1).
8) Install wire harness clamp to cylinder head cover.
9) Install ignition coil assemblies with high-tension cord.
10) Connect ignition coil couplers and clamp harness securely.
11) Install cylinder head upper cover.
12) Install air cleaner case and resonator.
13) Connect negative cable at battery.

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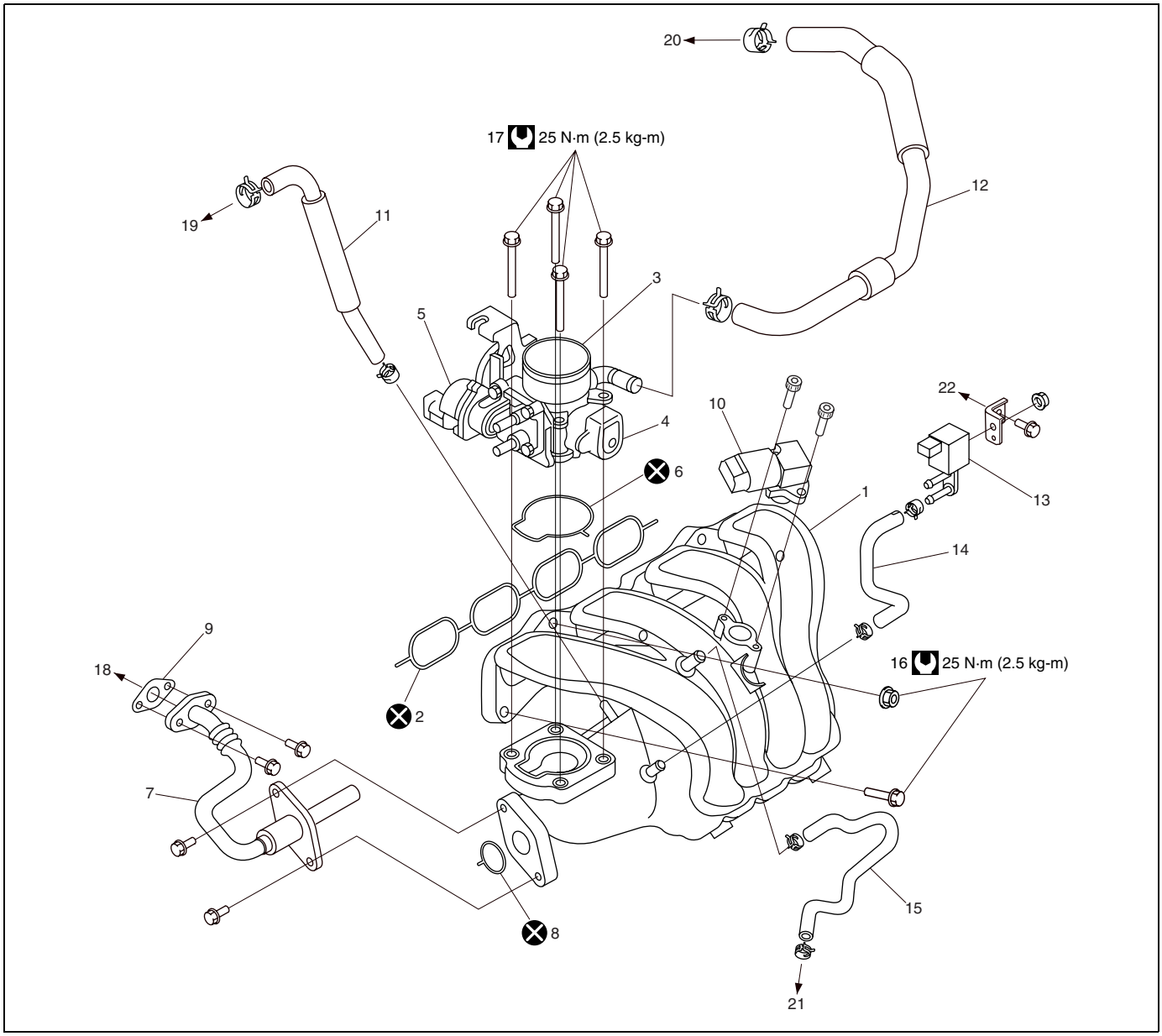
Throttle Body and Intake Manifold Components



1. Intake manifold	7. EGR pipe	13. EVAP canister purge valve	19. To PCV valve
2. Intake manifold O-Ring	8. O-Ring	14. EVAP canister purge valve hose	20. To cylinder head cover
3. Throttle body	9. Gasket	15. Brake booster hose	21. To brake booster
4. TP sensor	10. MAP sensor	16. Intake manifold mounting bolt and nut	22. To air cleaner case
5. IAC valve	11. PCV valve hose	17. Throttle body mounting bolt	Tightening torque
6. O-Ring	12. Breather hose	18. To EGR valve	Do not reuse.

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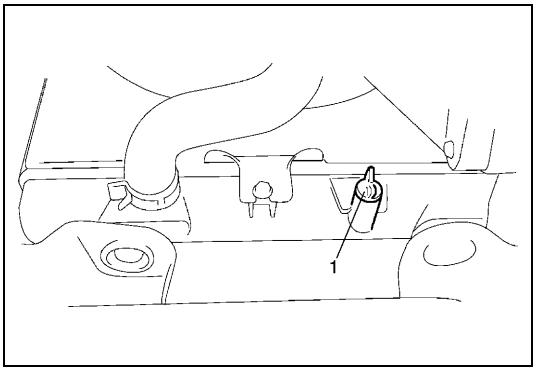
Throttle Body Removal and Installation

Removal

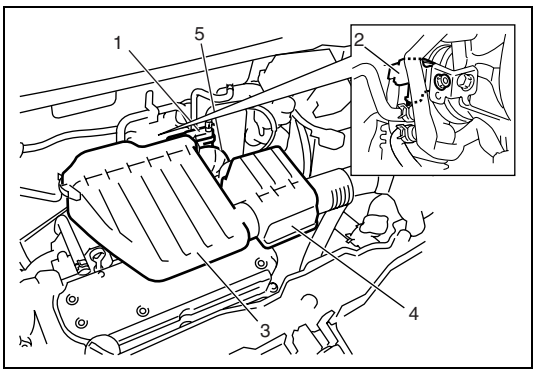
1) Relieve fuel pressure referring to “Fuel pressure Relief Procedure” in Section 6.
2) Disconnect negative cable at battery.



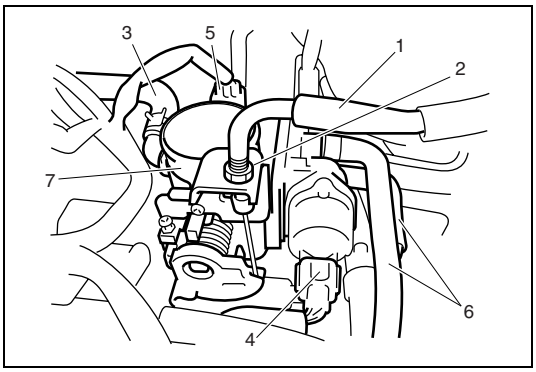
3) Drain coolant by loosening drain plug (1).

WARNING:

To help avoid danger of being burned, do not remove drain plug (1) and radiator cap while engine and radiator are still hot. Scalding fluid and steam can be blown out under pressure if plug and cap are taken off too soon.



4) Remove EVAP canister purge valve chamber (1) from air cleaner outlet hose.
5) Remove EVAP canister purge valve (2).
6) Remove air cleaner case (3) and resonator (4).
7) Remove air cleaner outlet hose (5).



8) Remove accelerator cable (1) by loosening lock nut (2).
9) Disconnect breather hose (3) and water hoses (6) from throttle body.
10) Disconnect IAC valve coupler (4) and TP sensor coupler (5).
11) Remove throttle body (7) from intake manifold.

Installation

Reverse removal procedure for installation noting the followings.

- Use new throttle body O-ring.
- Check to ensure that all removed parts are back in place. Reinstall any necessary parts which have not been reinstalled.
- Adjust accelerator cable play referring to “Accelerator Cable Adjustment” in Section 6E2.
- Refill cooling system referring to “Cooling System Flush and Refill (for M15 Engine Model)” in Section 6B.
- Upon completion of installation, turn ignition switch ON but engine OFF and check for fuel leaks.
- Finally, start engine and check for engine coolant leaks.

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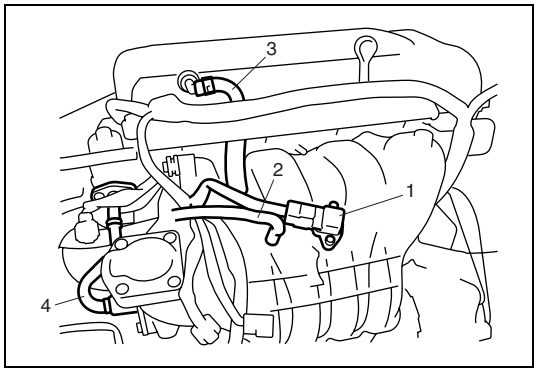
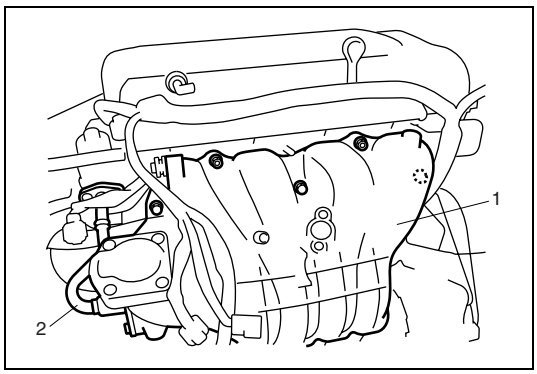
Intake Manifold Removal and Installation

Removal

1) Remove throttle body referring to “Throttle Body Removal and Installation” in this section.



2) Disconnect MAP sensor coupler (1).
3) Disconnect the following hoses:
   - Brake booster hose (2) from cylinder head cover
   - PCV hose (3) from PCV valve
4) Disconnect EGR pipe (4) from EGR valve.

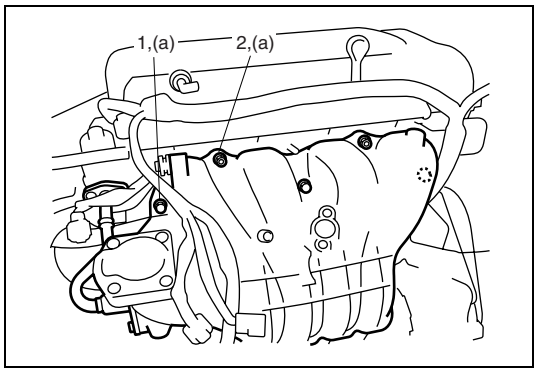


5) Remove intake manifold (1) and EGR pipe (2) from cylinder head, and then remove its gasket and O-ring.

Installation

Reverse removal procedure for installation noting the followings.

- Use new intake manifold O-ring.
- Use new EGR pipe gasket and O-ring.



- Tighten bolts (1) and nuts (2) to specified torque.

Tightening torque
Intake manifold bolt and nut
(a): 25 N·m (2.5 kg-m, 18.0 lb-ft)

- Check to ensure that all removed parts are back in place. Reinstall any necessary parts which have not been reinstalled.
- Adjust accelerator cable play referring to “Accelerator Cable Adjustment” in Section 6E2.
- Refill cooling system referring to “Cooling System Flush and Refill (for M15 Engine Model)” in Section 6B.
- Upon completion of installation, turn ignition switch ON but engine OFF and check for fuel leaks.
- Finally, start engine and check for engine coolant leaks.

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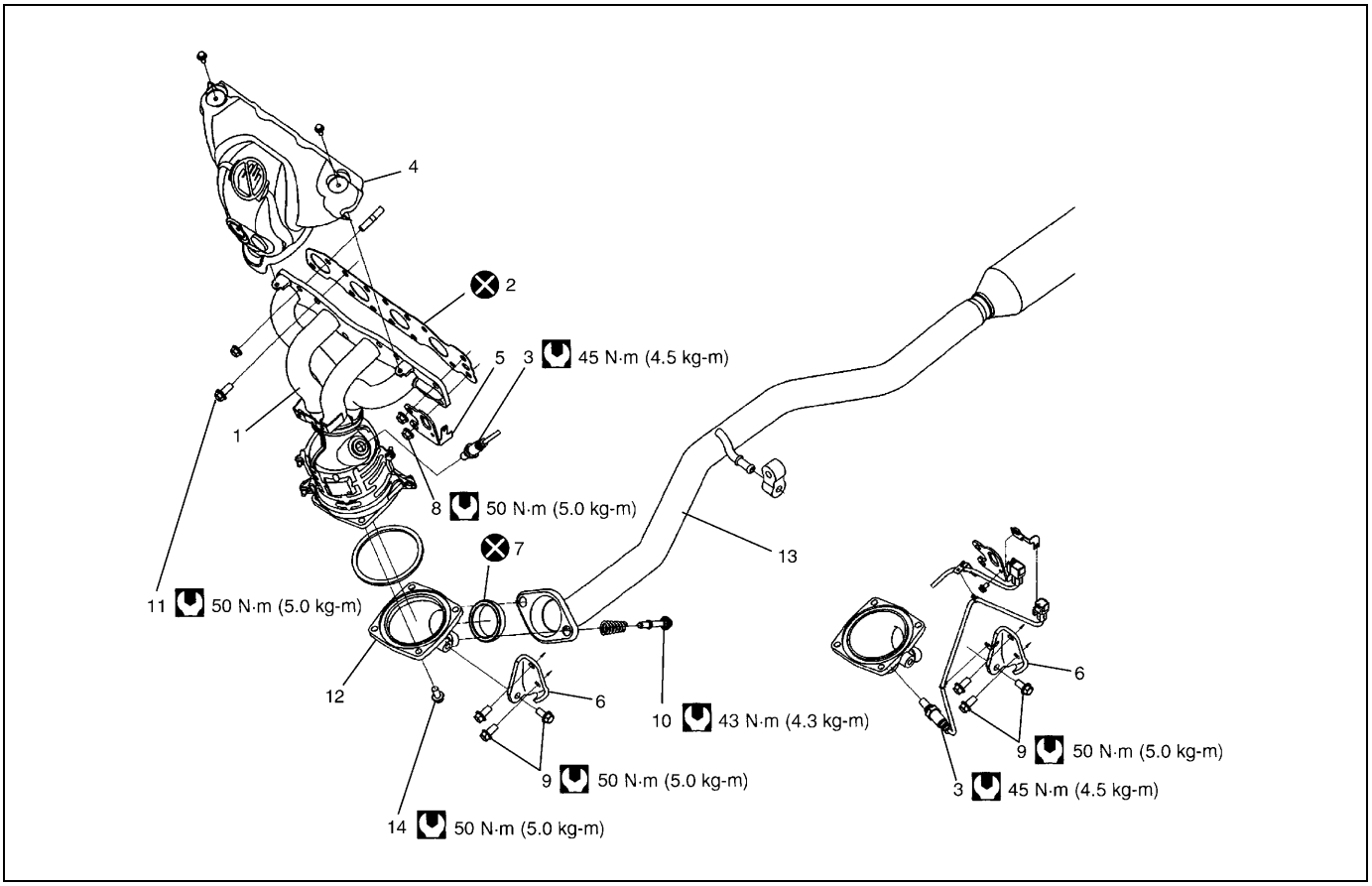
Exhaust Manifold Components



1. Exhaust manifold	7. Seal ring	13. Exhaust No.2 pipe
2. Exhaust manifold gasket	8. Exhaust manifold mounting nut	14. Exhaust No.1 pipe bolt
3. Heated oxygen sensor	9. Exhaust No.1 pipe stiffener bolt	Tightening torque
4. Exhaust manifold cover	10. Exhaust No.2 pipe bolt	Do not reuse.
5. Engine hook	11. Exhaust manifold mounting bolt	
6. Exhaust No.1 pipe stiffener	12. Exhaust No.1 pipe	

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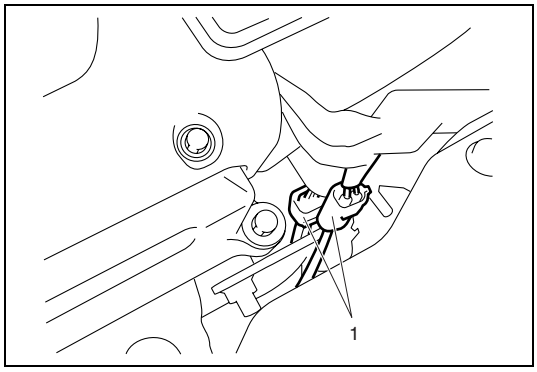
Exhaust Manifold Removal and Installation

WARNING:

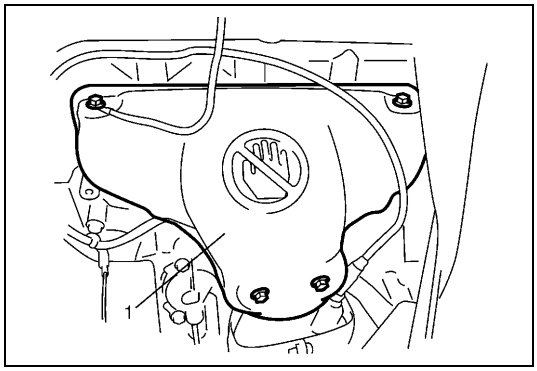
To avoid danger of being burned, do not service exhaust system while it is still hot. Service should be performed after system cools down.

Removal

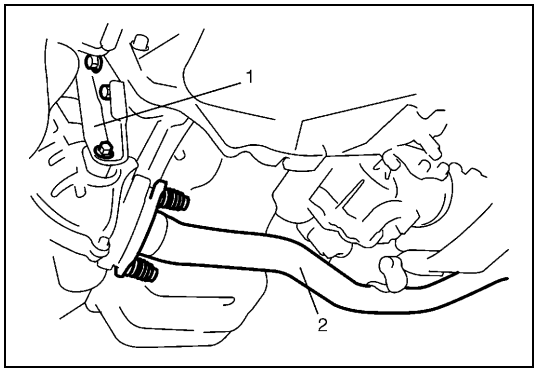
1) Disconnect negative cable at battery.
2) Remove front bumper with front grille referring to “Front Bumper and Rear Bumper” in Section 9.
3) Remove radiator referring to “Radiator” in Section 6B for equipped with A/C.
4) With hose connected, detach A/C condenser from vehicle body for equipped with A/C.



5) Disconnect heated oxygen sensor coupler (1) and detach it from its stay.



6) Remove exhaust manifold cover (1).



7) Remove exhaust manifold stiffener (1).
8) Disconnect exhaust No.1 pipe (2) from exhaust manifold.

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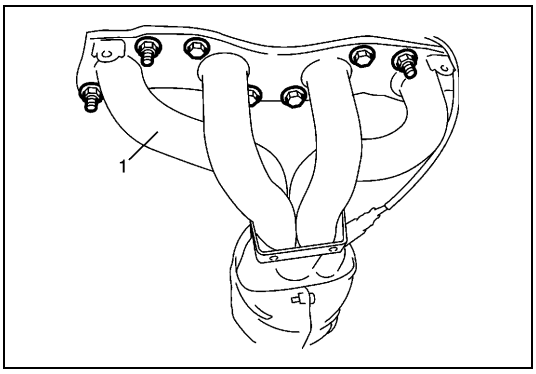
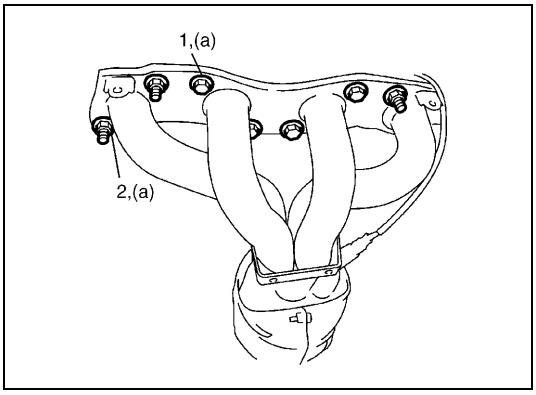


9) Remove exhaust manifold (1) and its gasket from cylinder head.

Installation

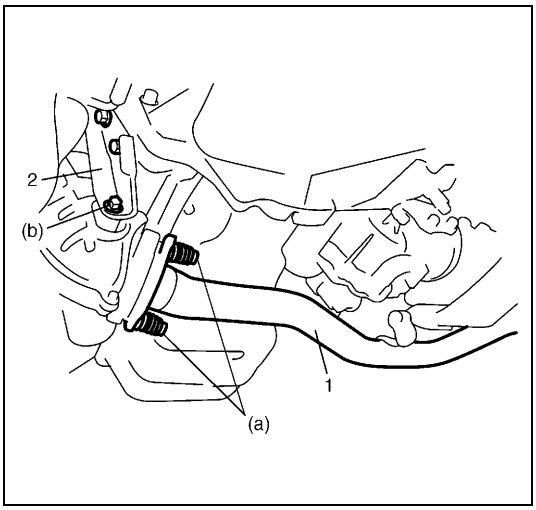


1) Install new gasket to cylinder head.
   Then install exhaust manifold.
   Tighten manifold bolts (1) and nuts (2) to specified torque.

Tightening torque
Exhaust manifold bolt and nut
(a): 50 N·m (5.0 kg-m, 36.5 lb-ft)

NOTE:

The figure on the left varies with specification.

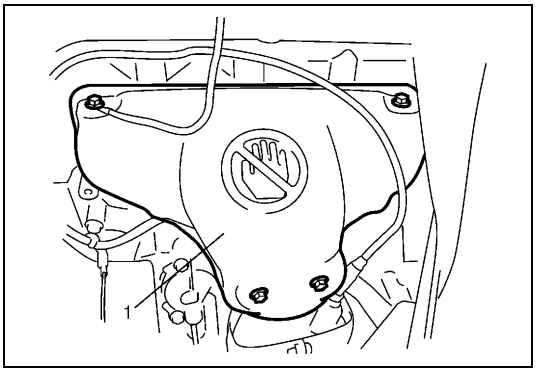


2) Install seal ring and connect exhaust No.2 pipe (1) to exhaust manifold.
   Before installing seal ring, check it for deterioration or damage, and replace as necessary.
   Tighten pipe fasteners to specified torque.

Tightening torque
Exhaust No.2 pipe bolt (a): 43 N·m (4.3 kg-m, 31.5 lb-ft)

3) Install exhaust manifold stiffener (2).
   Tighten exhaust manifold stiffener bolts to specified torque.

Tightening torque
Exhaust manifold stiffener bolt
(b): 50 N·m (5.0 kg-m, 36.5 lb-ft)



4) Install exhaust manifold cover (1).

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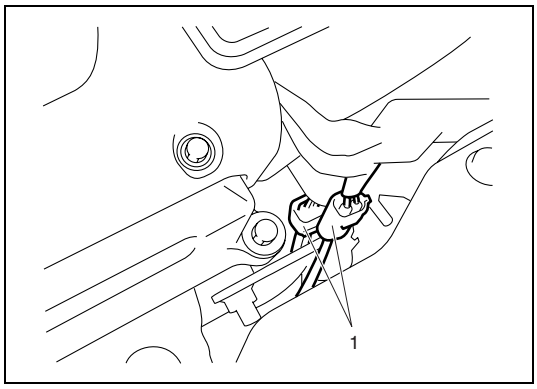

5) Connect heated oxygen sensor coupler (1) and fit coupler to bracket securely.
6) Install A/C condenser to vehicle body for equipped with A/C.
7) Install radiator referring to “RADIATOR” in Section 6B for equipped with A/C.
8) Install front bumper with front grille by referring to “Front Bumper and Rear Bumper” in Section 9.
9) Connect negative cable to battery.
10) Check exhaust system for exhaust gas leakage.

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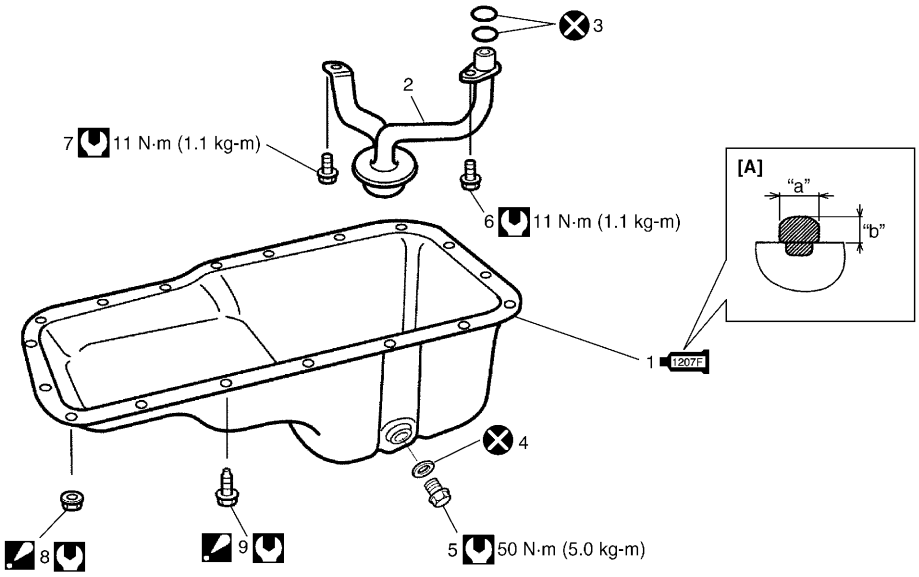
Oil Pan and Oil Pump Strainer Components

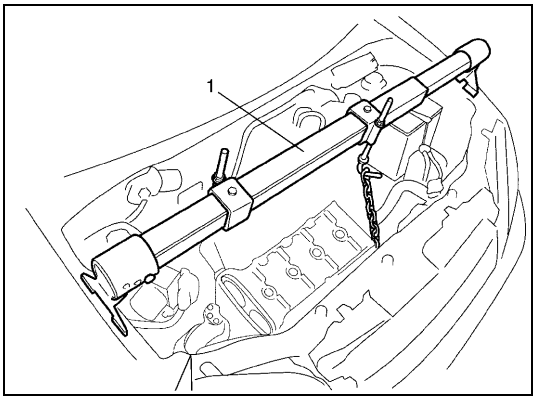


[A]: Sealant application amount	3. O-ring	8. Oil pan nut : Tighten 11 N·m (1.1 kg-m, 8.0 lb-ft) by the specified procedure.
"a": 3 mm (0.12 in.)	4. Gasket	9. Oil pan bolt : Tighten 11 N·m (1.1 kg-m, 8.0 lb-ft) by the specified procedure.
"b": 2 mm (0.08 in.)	5. Drain plug	Tightening torque
1207F 1. Oil pan : Apply sealant 99000-31250 to mating surface.	6. Strainer bolt	Do not reuse.
2. Strainer	7. Bracket bolt	

Oil Pan and Oil Pump Strainer Removal and Installation

Removal

1) Remove oil level gauge.
2) Drain engine oil by removing drain plug.
3) Support engine with supporting device (1).



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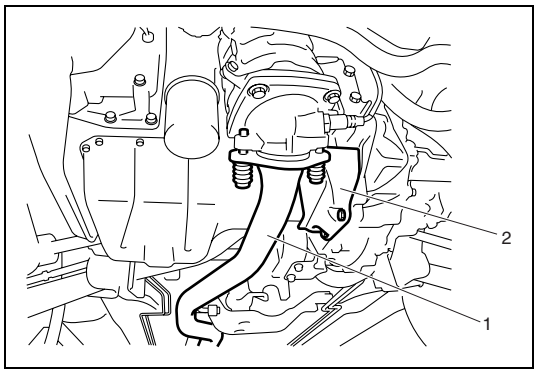
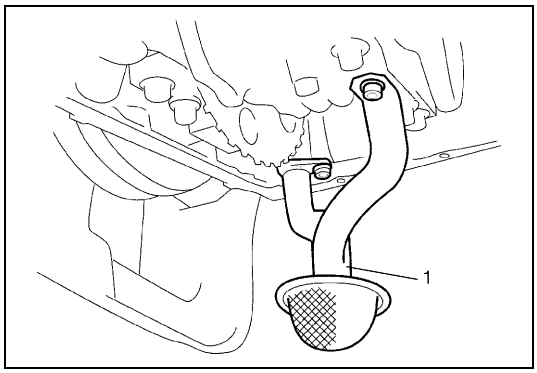
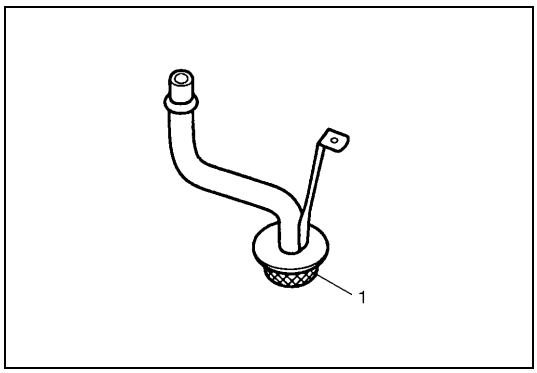


4) Remove exhaust No.2 pipe (1) and transaxle stiffener (2).
5) Remove engine rear mounting bracket.

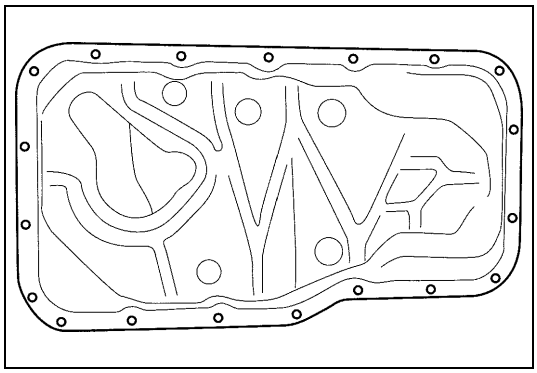


6) Remove oil pan and then oil pump strainer (1) from cylinder block.

Installation



1) Clean oil pump strainer screen (1).



2) Clean sealing surface on oil pan and cylinder block. Remove oil, old sealant and dust from sealing surface.

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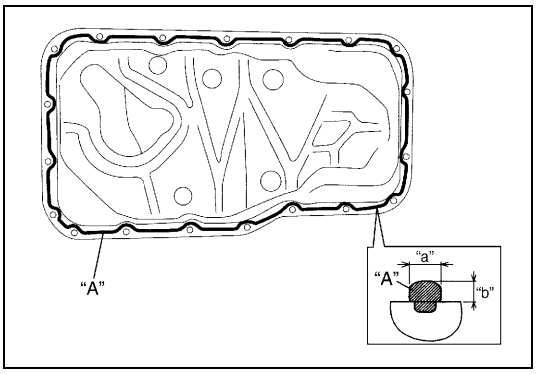
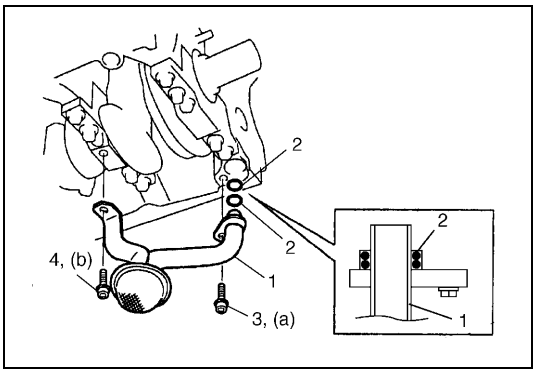


3) Apply sealant continuously to oil pan mating surface as shown in figure.

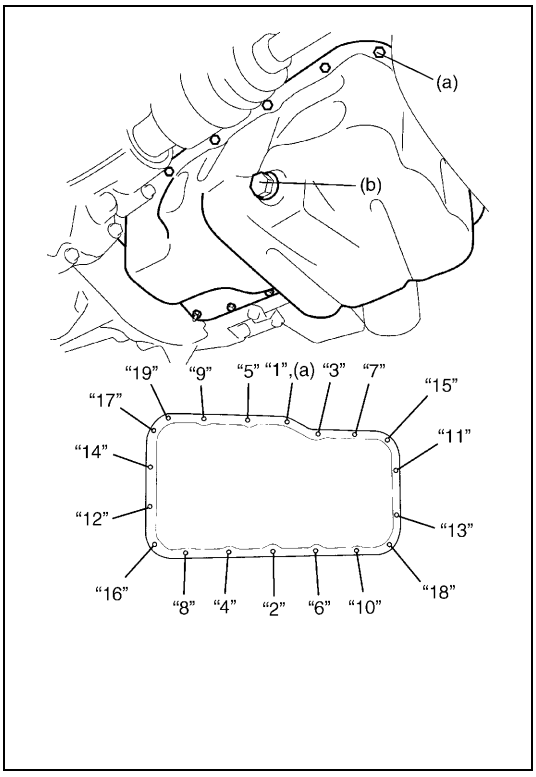
"A": sealant 99000-31250

Sealant amount for oil pan
Width "a": 3 mm (0.12 in.)
Height "b": 2 mm (0.08 in.)



4) Install new O-rings (2) in the position as shown in figure and install oil pump strainer (1).
Tighten strainer bolt (3) first and then bracket bolt (4) to specified torque.

Tightening torque
Oil pump strainer bolt (a): 11 N·m (1.1 kg-m, 8.0 lb-ft)
Oil pump strainer bracket bolt
(b): 11 N·m (1.1 kg-m, 8.0 lb-ft)



5) Install oil pan to cylinder block.
a) Fit upper oil pan to cylinder block.
b) Tighten oil pan bolts and nuts temporarily by hand.
c) Tighten oil pan bolts and nuts to specified torque by numerical order as shown in figure.

Tightening torque
Oil pan bolt and nut
(a): Tighten 11 N·m (1.1 kg-m, 8.0 lb-ft)
by the specified procedure

6) Install new gasket and drain plug to oil pan.
Tighten drain plug to specified torque.

Tightening torque
Oil pan drain plug bolt (b): 50 N·m (5.0 kg-m, 36.5 lb-ft)

7) Install Engine rear mounting bracket.

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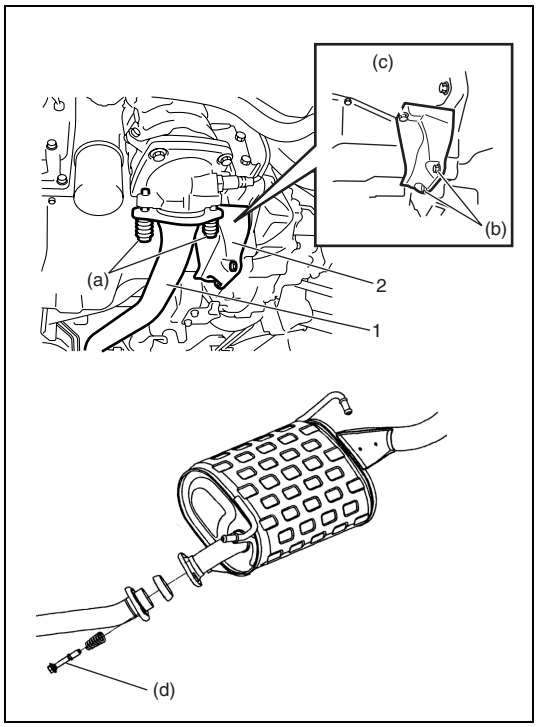

8) Install transaxle stiffener (2).
   Tighten transaxle stiffener bolts (b) first and next (c) with specified torque.

Tightening torque
Transaxle stiffener bolt (b and c):
Tighten 50 N·m (5.0 kg-m, 36.5 lb-ft)
by the specified procedure

9) Install exhaust No.2 pipe (1).
   Tighten bolts to specified torque.

Tightening torque
Exhaust No.2 pipe bolt (a): 43 N·m (4.3 kg-m, 31.5 lb-ft)
Exhaust No.2 pipe bolt (d): 43 N·m (4.3 kg-m, 31.5 lb-ft)

10) Install oil level gauge.
11) Refill engine with engine oil referring to “Engine Oil and Filter” in Section 0B.
12) Verify that there is no engine oil leakage and exhaust gas leakage at each connection.

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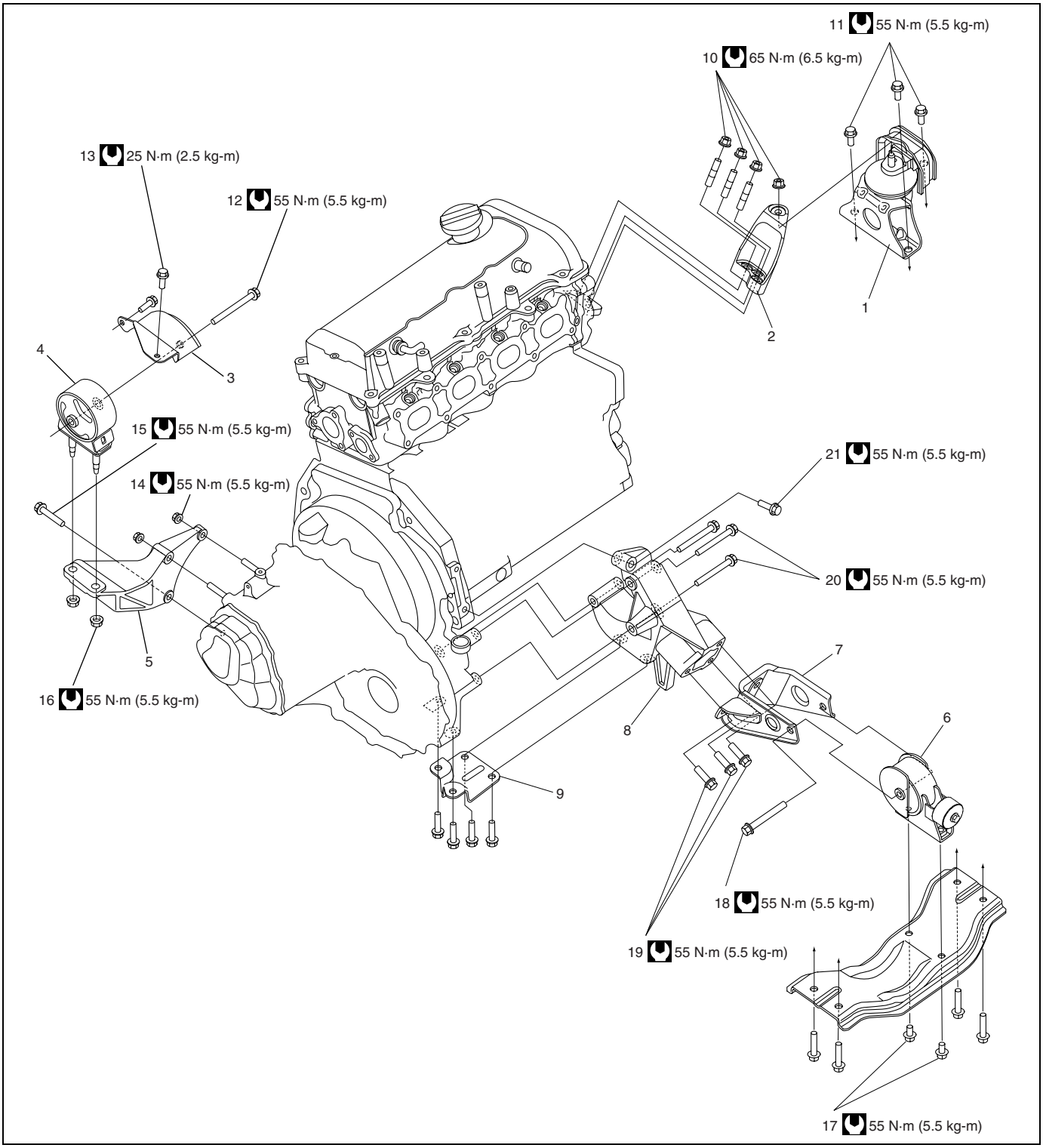
Engine Mountings Components



1. Engine right mounting	9. Engine rear mounting bracket stiffener	17. Engine rear mounting bolt
2. Engine right engine side bracket	10. Engine right mounting nut	18. Engine rear mounting bolt
3. Engine left body side bracket	11. Engine right mounting bolt	19. Engine rear mounting No.1 bracket bolt
4. Engine left mounting	12. Engine left mounting bolt	20. Engine rear mounting No.2 bracket bolt
5. Engine left mounting bracket	13. Engine left body side bracket bolt	21. Engine rear mounting No.2 bracket bolt
6. Engine rear mounting (for FWD vehicle)	14. Engine left mounting bracket nut	Tightening torque
7. Engine rear mounting No.1 bracket	15. Engine left mounting bracket bolt	
8. Engine rear mounting No.2 bracket	16. Engine left mounting nut	

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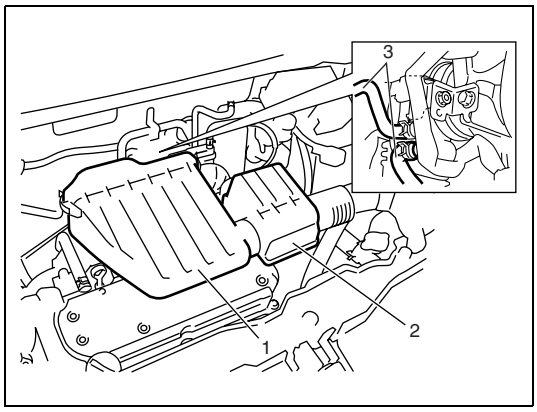
Unit Repair Overhaul

Engine Assembly Removal and Installation

Removal

1) Relieve fuel pressure referring to “Fuel Pressure Relief Procedure” in Section 6.
2) Disconnect negative and positive cables at battery.
3) Remove engine hood after disconnecting windshield washer hose.
4) Remove right and left side engine under covers.
5) Remove A/C compressor belt by referring to “Compressor Drive Belt” in Section 1B (if equipped).
6) Drain engine oil referring to “Engine Oil and Filter” in Section 0B.
7) Drain transaxle oil referring to “Oil Change” in Section 7A2.
8) Drain coolant by referring to “Cooling System Flush and Refill (for M15 Engine Model)” in Section 6B.



9) Remove air cleaner case (1) and resonator (2).
10) Remove canister purge hose (3) from EVAP canister purge valve.
11) With hose connected, detach A/C compressor from its bracket (if equipped).

CAUTION:
Suspend removed A/C compressor at a place where no damage will be caused during removal and installation of engine assembly.

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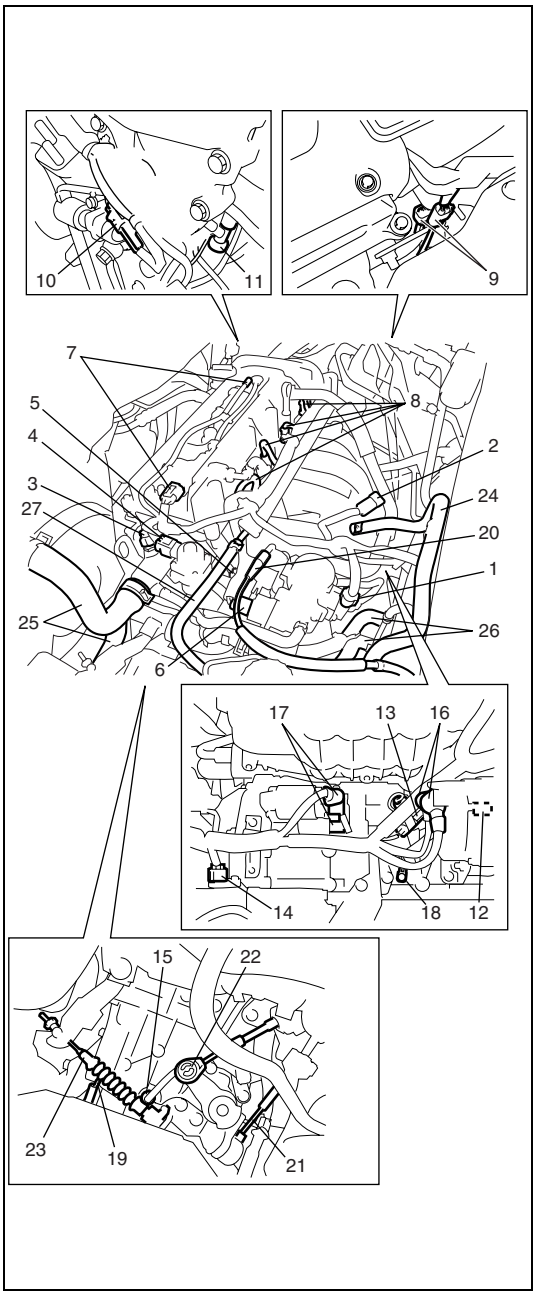
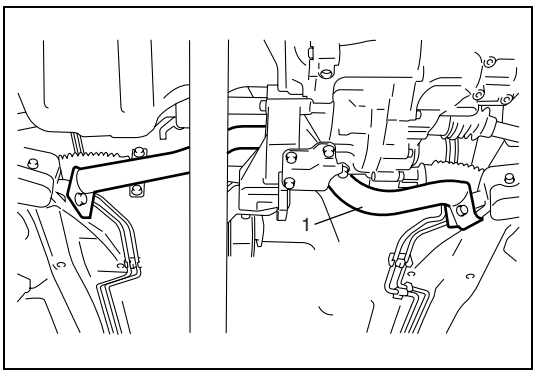


12) Disconnect the following electric lead wires:
- TP sensor (1)
- MAP sensor (2)
- ECT sensor (3)
- EGR valve (4)
- CMP sensor (5)
- IAC valve (6)
- Ignition coil assembly (7)
- Injectors (8)
- Heated oxygen sensor (9)
- Oil control valve (10)
- Engine oil pressure switch (11)
- CKP sensor (12)
- Knock sensor (13)
- VSS (14)
- Back up light switch (15)
- Generator (16)
- Starting motor (17)
- Ground terminal (18) from cylinder block
- Battery ground cable (19) from transaxle
- Magnet clutch switch of A/C compressor (if equipped)
- Each wire harness clamps

13) Remove fuse box from its bracket.
14) Disconnect the following cables :
- Accelerator cable (20)
- Gear select control cable (21)
- Gear shift control cable (22)
- Clutch cable (23)

15) Disconnect the following hoses:
- Brake booster hose (24) from intake manifold
- Radiator inlet and outlet hoses (25) from each pipe
- Heater inlet and outlet hoses (26) from each pipe
- Fuel feed hoses (27) from fuel feed pipe

16) Remove exhaust No.2 pipe referring to “Exhaust Manifold Removal and Installation” in this section.
17) Disconnect right and left drive shaft joints to differential gear referring to “Drive Shaft Assembly” in Section 4A.
For engine and transaxle removal, it is not necessary to remove drive shafts from steering knuckle.



18) Remove cross member (1).
19) Install lifting device.

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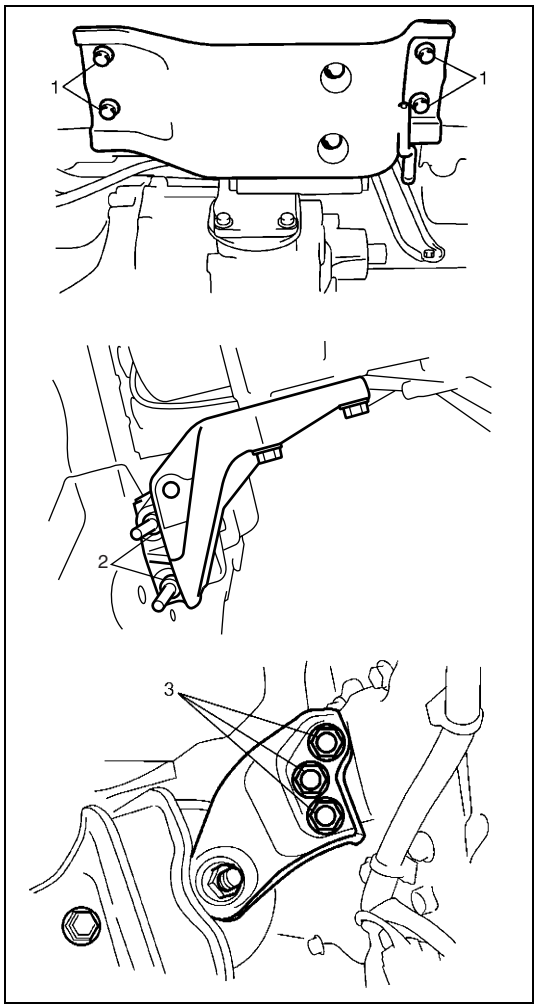
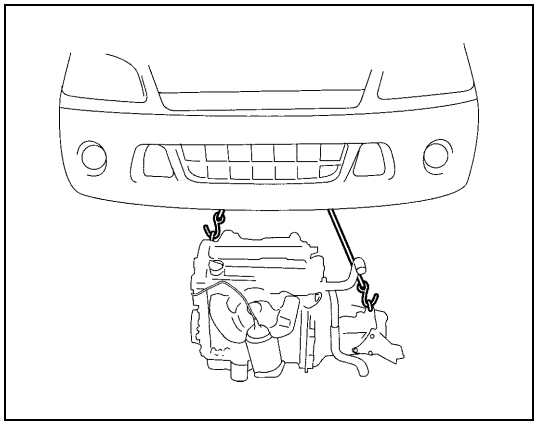


20) Remove engine rear mounting member bolts (1), engine left mounting bracket nuts (2) and engine right mounting nuts (3).



21) Before removing engine with transaxle from body, recheck to make sure all hoses, electric wires and cables are disconnected from engine and transaxle.
22) Lower engine with transaxle from body.

NOTE:

Before lowering engine, to avoid damage to A/C compressor, raise it through clearance made on engine crankshaft pulley side. At this time, use care so that no excessive force is applied to hoses.

23) Disconnect transaxle from engine referring to “Transmission Unit” in Section 7A2.
24) Remove clutch cover and clutch disk referring to “Clutch Cover, Clutch Disc and Flywheel” in Section 7C1.

Installation

1) Install clutch cover and clutch disk referring to “Clutch Cover, Clutch Disc and Flywheel Removal and Installation” in Section 7C1.
2) Connect transaxle to engine referring to “Transaxle Unit Dismounting and Remounting” in Section 7A2.

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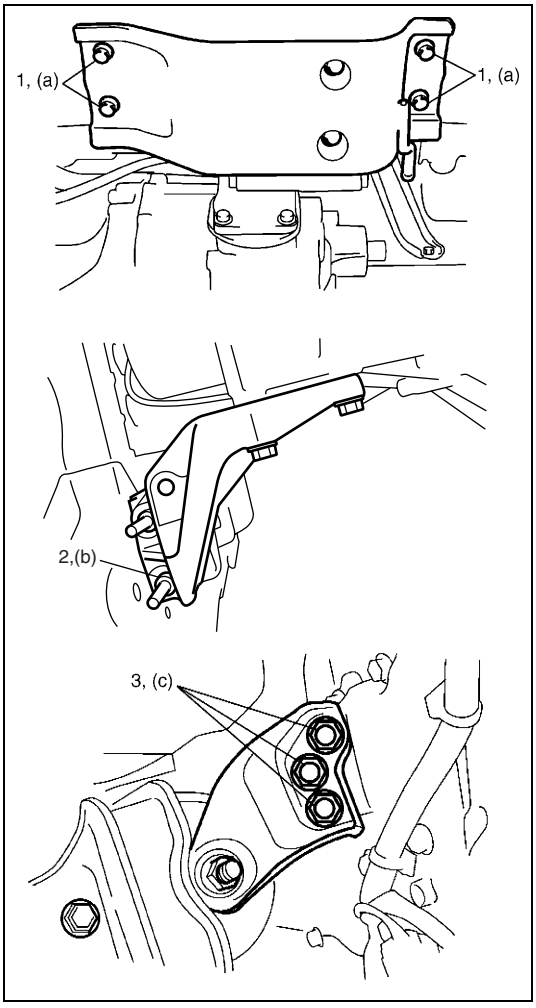
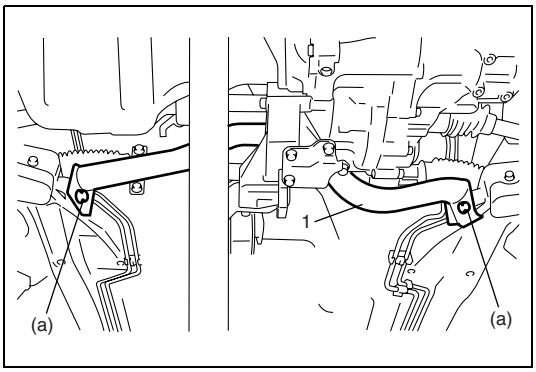
3) Lift engine with transaxle into engine compartment, but do not remove lifting device.



4) Install engine rear mounting member bolts (1), engine left mounting bracket nuts (2) and engine right mounting nuts (3).
   Tighten these bolts and nuts to specified torque.

Tightening torque
Engine rear mounting member bolt
(a): 55 N·m (5.5 kg-m, 40.0 lb-ft)
Engine left mounting bolt
(b): 55 N·m (5.5 kg-m, 40.0 lb-ft)
Engine right mounting bracket nut
(c): 65 N·m (6.5 kg-m, 47.0 lb-ft)

5) Remove lifting device.



6) Install cross member (1).
   Tighten bolts to specified torque.

Tightening torque
Cross member bolt
(a): 60 N·m (6.0 kg-m, 43.0 lb-ft)

7) Connect drive shaft joints referring to Section 4A.
8) Install exhaust No.2 pipe referring to “Exhaust Manifold Removal and Installation” in this section.
9) Reverse disconnected hoses, cables and electric wires for connection.
10) Install air cleaner case and resonator.
11) Install A/C compressor to its bracket (if equipped).
12) Adjust A/C compressor belt tension (if equipped) referring to “Compressor Drive Belt” in Section 1B.
13) Adjust accelerator cable play referring to “Accelerator Cable Adjustment” in Section 6E1.
14) Check to ensure that all removed parts are back in place. Reinstall any necessary parts which have not been reinstalled.
15) Refill cooling system with coolant referring to “Cooling System Flush and Refill (for M15 Engine Model)” in Section 6B.

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16) Refill engine with engine oil referring to “Engine Oil and Filter” in Section 0B.
17) Refill transaxle with transaxle oil referring to “Oil Change” in Section 7A2.
18) Connect negative cable at battery.
19) Verify that there is no fuel leakage, coolant leakage, oil leakage and exhaust gas leakage at each connection.

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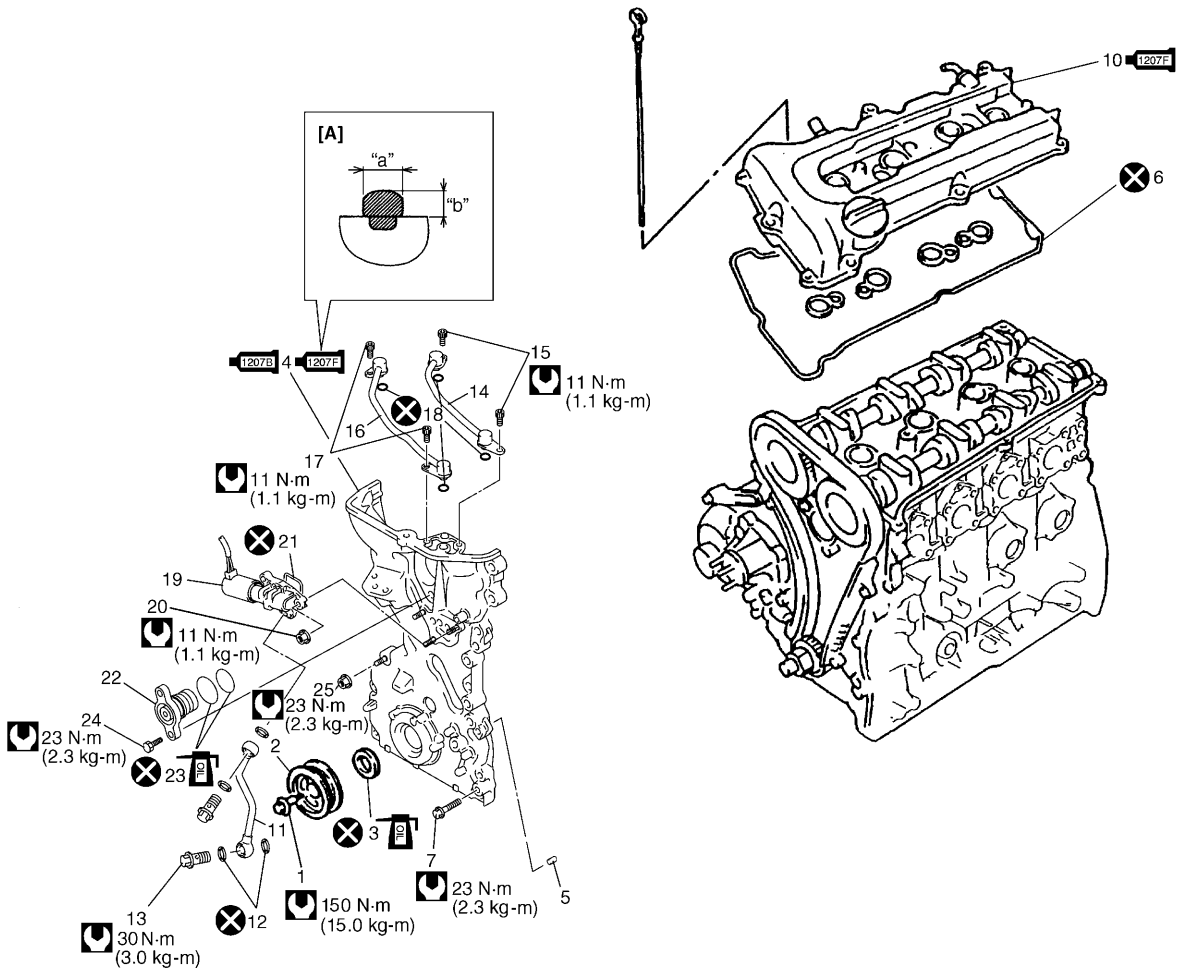
Timing Chain Cover Components



[A]: Sealant application amount	8. Oil pan mounting bolt	18. O ring
"a": 3 mm (0.12 in.)	9. Oil pan mounting nut	19. Oil control valve
"b": 2 mm (0.08 in.)	1207F 10. Cylinder head cover : Apply sealant 99000-31250 to the sealing point for timing chain cover mating surface and cylinder head gasket sealing point referring to "Installation" under "Cylinder Head Cover Removal and Installation" in this section.	20. Oil control valve mounting nut
1. Crankshaft pulley bolt	11. Oil gallery pipe No.1	21. O ring
2. Crankshaft pulley	12. Copper washer	22. Cap
OIL 3. Oil seal : Apply engine oil to oil seal lip.	13. Oil gallery pipe No.1 bolt	OIL 23. O ring
1207B 1207F 4. Timing chain cover : Apply sealant 99000-31140 to the mating surface of cylinder and cylinder head. : Apply sealant 99000-31250 to the mating surface of timing chain cover referring to the figure of Step 1) of "Installation" under "Timing Chain Cover Removal and Installation" in this section.	14. Oil gallery pipe No.2	24. Cap bolt
5. Pin	15. Oil gallery pipe No.2 bolt	25. Timing chain cover mounting nut
6. Cylinder head cover gasket	16. Oil gallery pipe No.3	Tightening torque
7. Timing chain cover mounting bolts	17. Oil gallery pipe No.3 bolt	Do not reuse.

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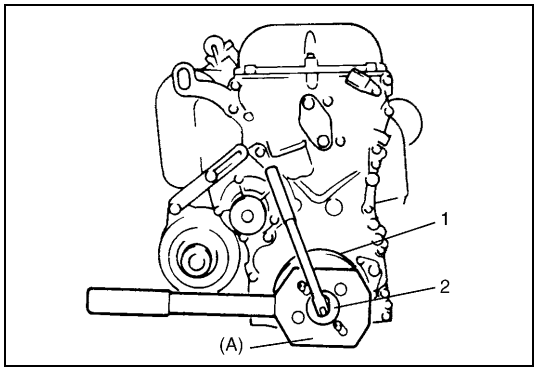
Timing Chain Cover Removal and Installation

Removal

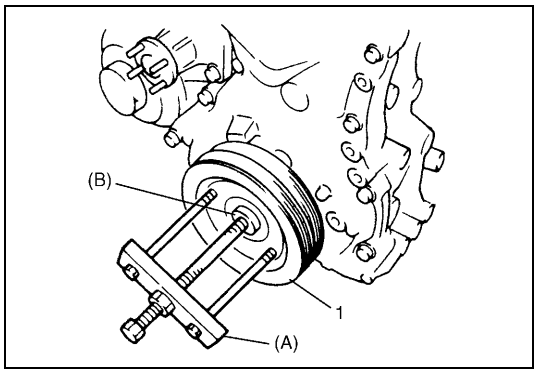
CAUTION:
- **Keep working table, tools and hands clean while overhauling.**
- **Use special care to handle aluminum parts so as not to damage them.**
- **Do not expose removed parts to dust. Keep them always clean.**

1) Remove engine assembly from vehicle referring to “Engine Assembly Removal and Installation” in this section.



2) Remove crankshaft pulley bolt (2).
   To lock crankshaft pulley (1), use special tool with it as shown in figure.

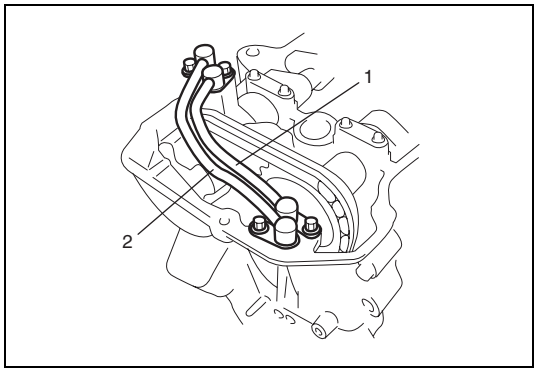
   Special tool
   (A) : 09917-68221



3) Remove crankshaft pulley (1).
   If it is hard to remove, use special tools as shown in figure.

   Special tool
   (A) : 09944-36011
   (B) : 09926-58010

4) Remove cylinder head cover referring to “Cylinder Head Cover Removal and Installation” in this section.
5) Remove oil pan referring to “Oil Pan and Oil Pump Strainer Removal and Installation” in this section.
6) Remove water pump pulley.



7) Remove oil gallery pipes No.2 (1) and No.3 (2).

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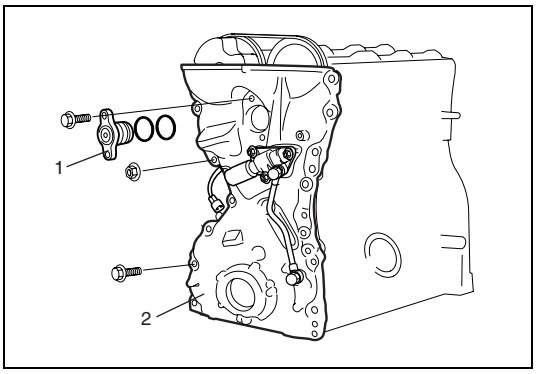
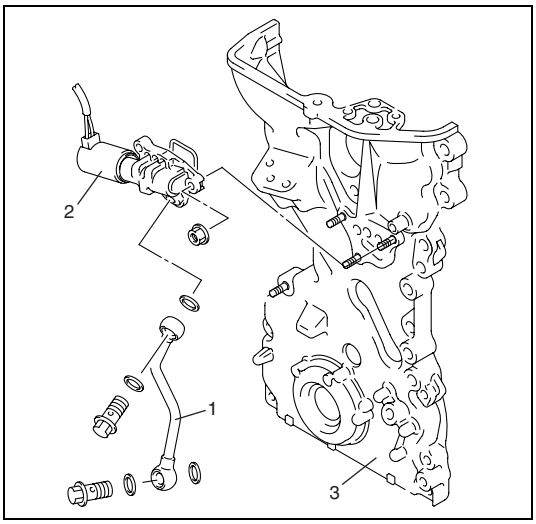


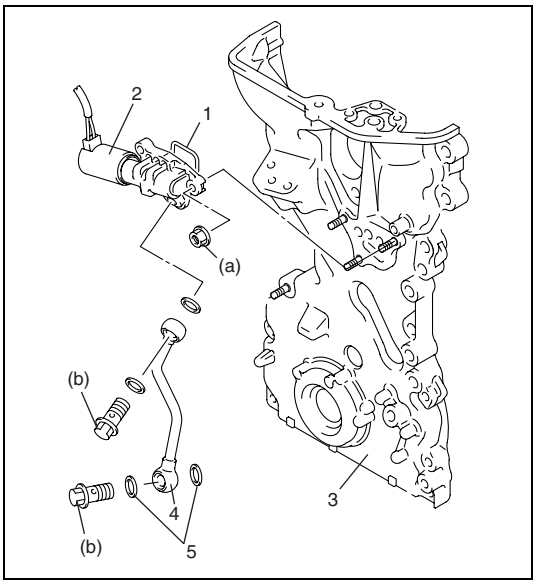
8) Remove cap (1) from timing chain cover (2).
9) Remove timing chain cover.



10) Remove oil gallery pipe No.1 (1) and oil control valve (2) from timing chain cover (3).

Installation

1) Clean sealing surface on timing chain cover, cylinder block and cylinder head.
   Remove oil, old sealant and dust from sealing surface.



2) Install new O-ring (1) to oil control valve (2).
3) Install oil control valve to timing chain cover (3).
   Tighten nuts to specification.

Tightening torque
Oil control valve mounting nut
(a): 11 N·m (1.1 kg-m, 8.0 lb-ft)

4) Install oil gallery pipe No.1 (4) with new copper washers (5) to timing chain cover.
   Tighten bolts to specification.

Tightening torque
Oil gallery pipe No.1 bolt
(b): 30 N·m (3.0 kg-m, 21.5 lb-ft)

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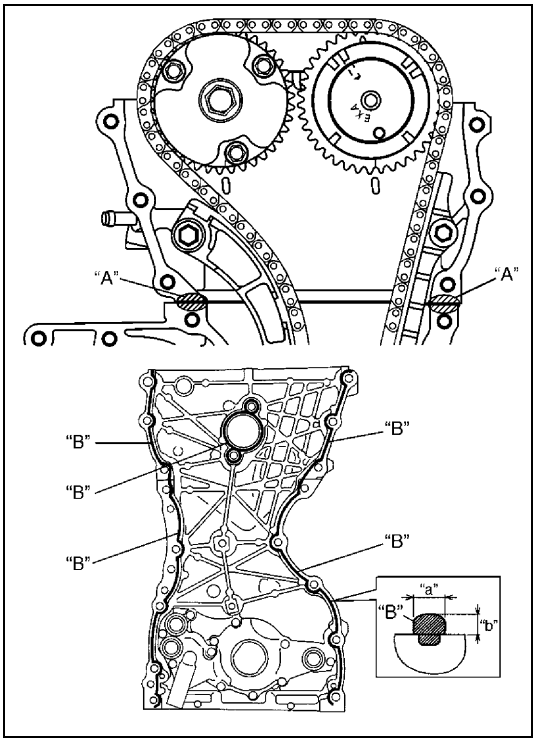
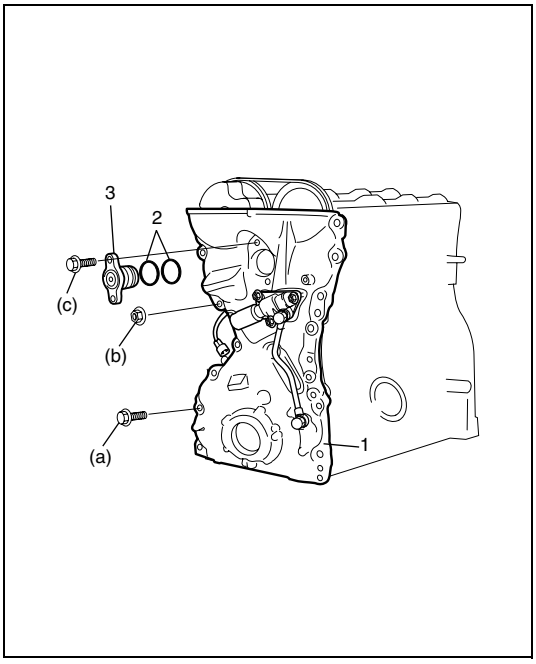


5) Apply sealant "A" to mating surface of cylinder and cylinder head and "B" to mating surface of timing chain cover as shown in figure.

"A": Sealant 99000-31140
"B": Sealant 99000-31250

Sealant amount for timing chain cover
Width "a": 3 mm (0.12 in.)
Height "b": 2 mm (0.08 in.)



6) Apply engine oil to oil seal lip, then install timing chain cover (1).
Tighten bolts and nut to specified torque.

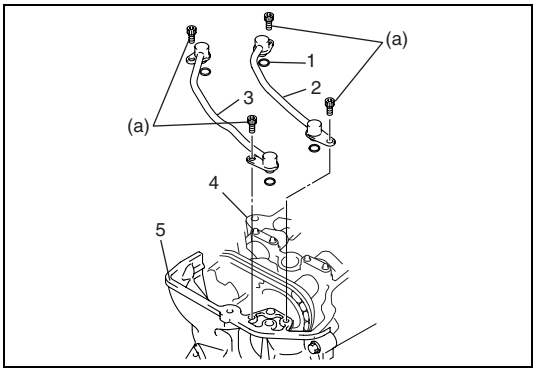
NOTE:

Before installing timing chain cover, check that pin is securely fitted.

Tightening torque
Timing chain cover bolt (a): 23 N·m (2.3 kg-m, 17.0 lb-ft)
Timing chain cover nut (b): 23 N·m (2.3 kg-m, 17.0 lb-ft)

7) Apply engine oil to new O-rings (2) and install them to cap (3).
8) Install cap (3) to timing chain cover (1).
Tighten bolts to specified torque.

Tightening torque
Cap bolt (c): 23 N·m (2.3 kg-m, 17.0 lb-ft)



9) Install new O-ring (1) to oil gallery pipes No.2 (2) and No.3 (3).
10) Install oil gallery pipes No.2 and No.3 to cylinder head (4) and timing chain cover (5).
Tighten bolts to specified torque.

Tightening torque
Oil gallery pipes No.2 and No.3 bolt
(a): 11 N·m (1.1 kg-m, 8.0 lb-ft)

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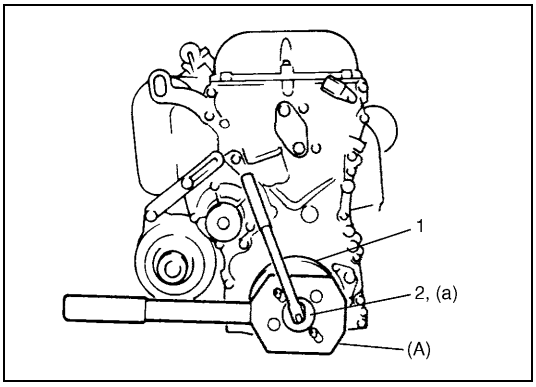
11) Install water pump pulley.
12) Install cylinder head cover referring to “Cylinder Head Cover Removal and Installation” in this section.
13) Install oil pan referring to “Oil Pan and Oil Pump Strainer Removal and Installation” in this section.



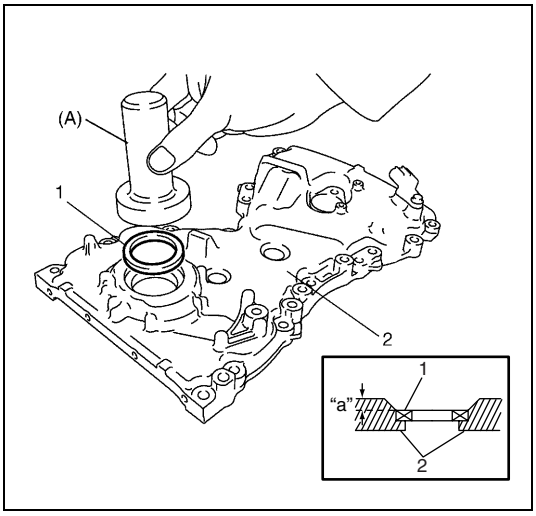
14) Install crankshaft pulley (1). Tighten bolt (2) to specified torque. To lock crankshaft pulley, use special tool with it as shown in the figure.

Special tool
(A) : 09917-68221

Tightening torque
Crankshaft pulley bolt (a) : 150 N·m (15.0 kg-m, 108.5 lb-ft)

15) Install engine assembly to vehicle referring to “Engine Assembly Removal and Installation” in this section.

Timing Chain Cover Inspection



Oil seal

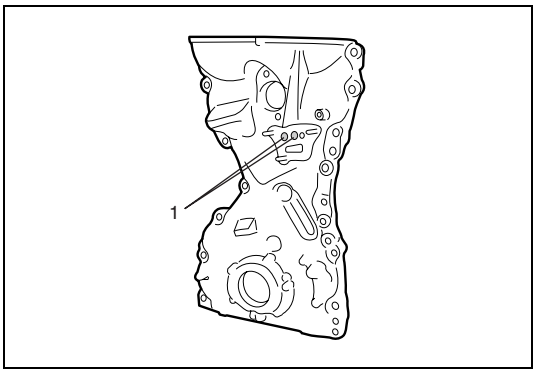
- Check oil seal (1) lip for fault or other damage.
  Replace as necessary.

NOTE:

When installing new oil seal, press fit to timing chain cover (2) by using special tool (Bearing installer) as shown in the figure.

Special tool
(A): 09913-75810

Drive in dimension
“a”: 1.5 mm (0.06 in.)



Timing chain cover

Inspect strainer (1) of oil passage for driving intake cam timing sprocket assembly (VVT actuator).
If clog or foreign matter exists, clean strainer.

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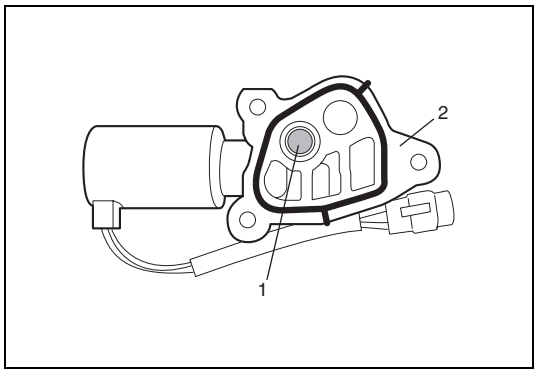
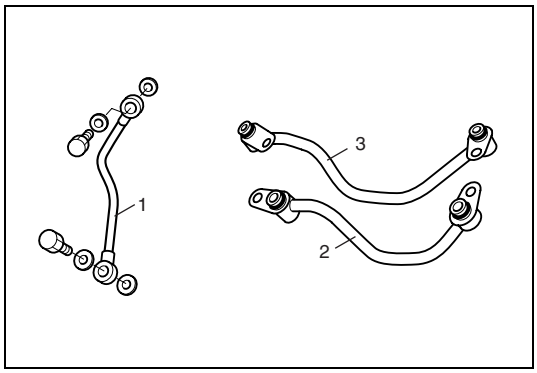


Oil control valve

Inspect strainer (1) and mating surface (2) of oil control valve.
Clean oil control valve.



Oil gallery pipe

Inspect oil gallery pipes No.1 (1), No.2 (2) and No.3 (3).
Replace if crack, deformation or clog exists.

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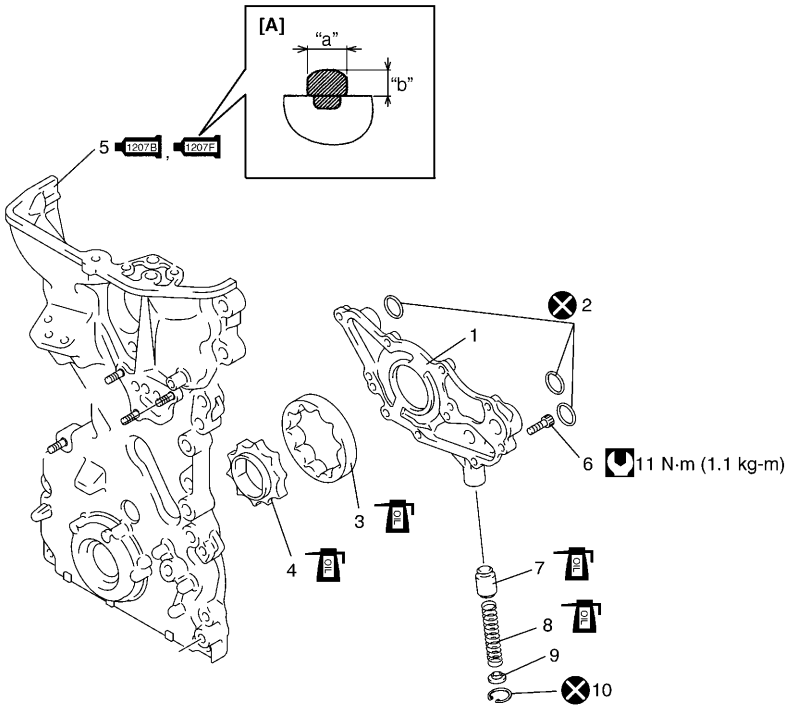
Oil Pump Components



[A] : Sealant application amount	4. Inner rotor	10. Circlip
"a" : 3 mm (0.12 in.)	1207B 1207F 5. Timing chain cover : Apply sealant 99000-31140 to the mating surface of cylinder and cylinder head. : Apply sealant 99000-31250 to mating surface of timing chain cover referring to the figure of Step 4) of "Installation" under "Timing Chain Cover Removal and Installation" in this section.	Tightening torque
"b" : 2 mm (0.08 in.)	6. Rotor plate bolt	Do not reuse.
1. Rotor plate	7. Relief valve	Apply thin coat of engine oil to sliding surface of each parts.
2. O ring	8. Spring	
3. Outer rotor	9. Retainer	

Oil Pump Removal and Installation

Removal

Remove timing chain cover referring to "Timing Chain Cover Removal and Installation" in this section.

Installation

For installation, refer to "Timing Chain Cover Removal and Installation" in this section.

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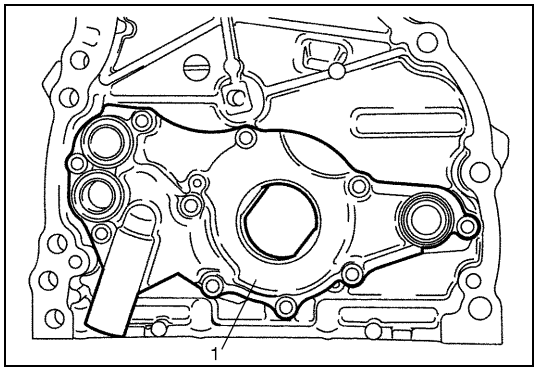
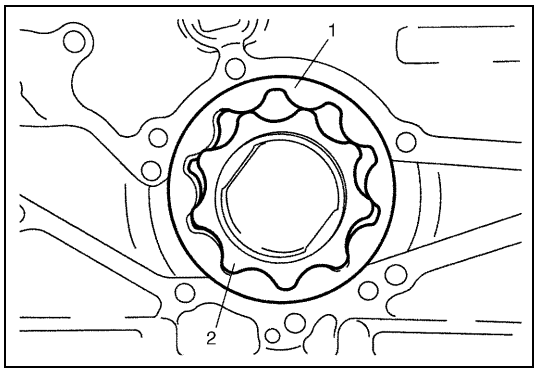
Oil Pump Disassembly and Assembly

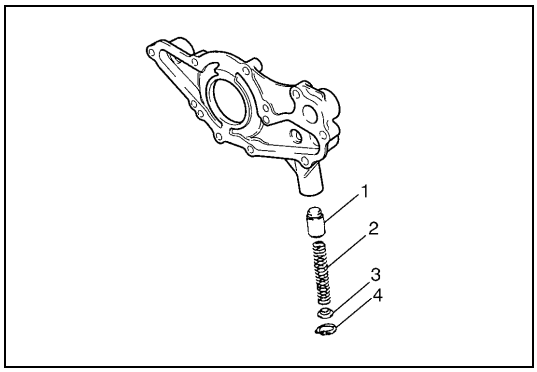
Disassembly



1) Remove rotor plate (1) by removing its mounting bolts.



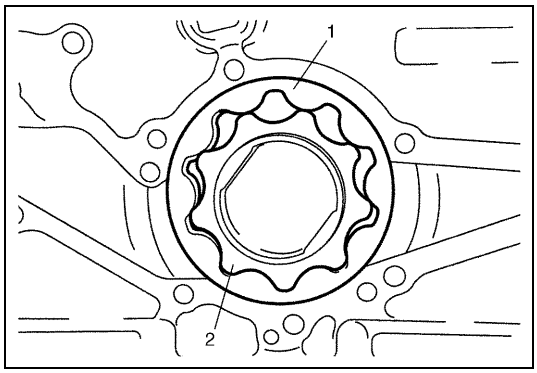
2) Remove outer rotor (1) and inner rotor (2).



3) Remove relief valve (1), spring (2) and retainer (3) by removing circlip (4).

Assembly

1) Wash, clean and then dry all disassembled parts.
2) Apply thin coat of engine oil to inner and outer rotors, oil seal lip portion, inside surfaces of oil pump case and plate.



3) Install outer (1) and inner rotors (2) to oil pump case.

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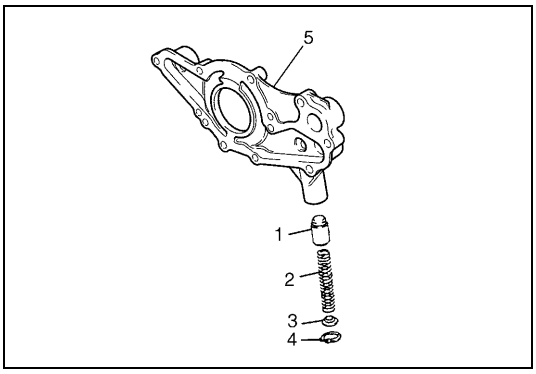
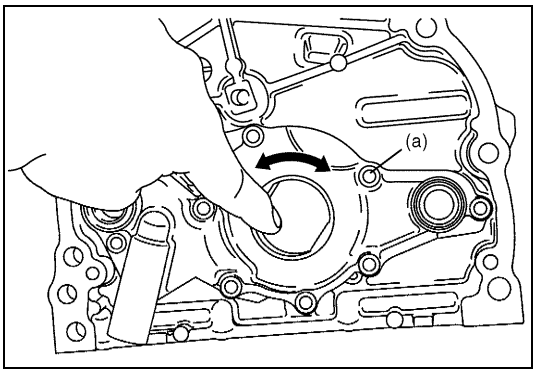


4) Apply engine oil to relief valve (1) and spring (2), and install them with retainer (3) and new circlip (4) to rotor plate (5).

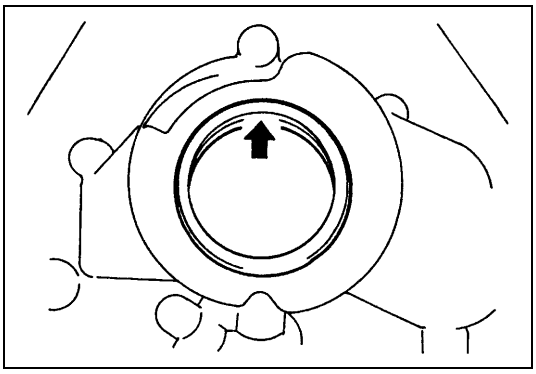


5) Install rotor plate and tighten all bolts to specified torque. After installing plate, check to be sure that rotors turn smoothly by hand torque (approx. 0.3 N·m (0.03 kg-m, 0.25 lb-ft)).

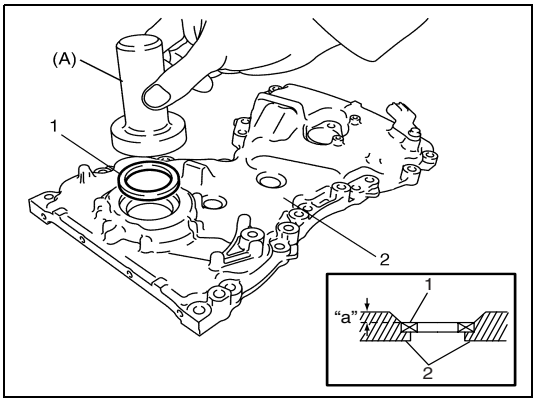
Tightening torque
Oil pump rotor plate bolt (a): 11 N·m (1.1 kg-m, 8.0 lb-ft)

Oil Pump Inspection

Oil seal



- Check oil seal lip for fault or other damage. Replace as necessary.



NOTE:

When installing new oil seal (1), press-fit it to oil pump case (2) by using special tool as shown in the figure.

Special tool
(A) : 09913-75810

Drive in dimension
"a": 1.5 mm (0.06 in.)

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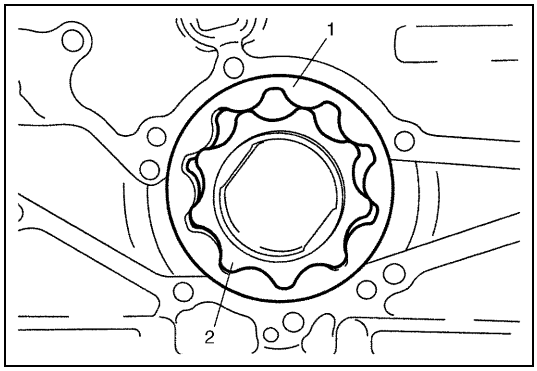
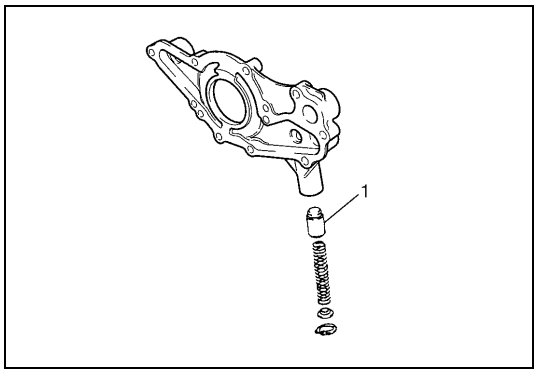
Oil pump assembly

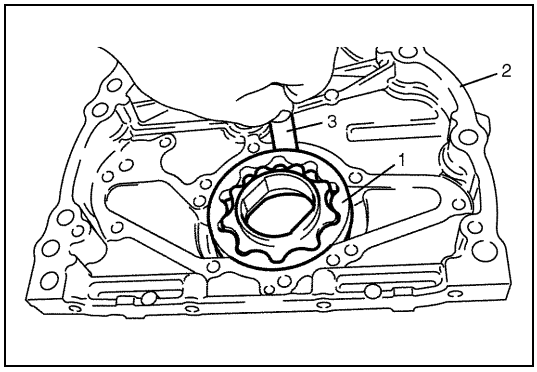


- Check outer (1) and inner rotors (2), rotor plate, and oil pump case for excessive wear or damage.



- Check relief valve (1) for excessive wear or damage and operates smoothly.

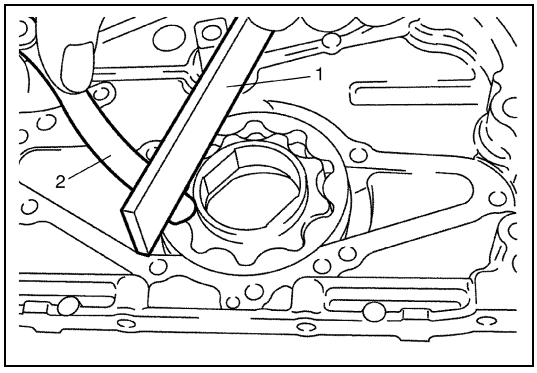
Radial clearance



Check radial clearance between outer rotor (1) and case (2) using thickness gauge (3).
If clearance exceeds its limit, replace oil pump assembly.

Limit on radial clearance between outer rotor and case for oil pump
: 0.310 mm (0.0122 in.)

Side clearance



Using straight edge (1) and thickness gauge (2), measure side clearance.
If clearance exceeds its limit, replace oil pump assembly.

Limit on side clearance for oil pump inner rotor
: 0.15 mm (0.0059 in.)

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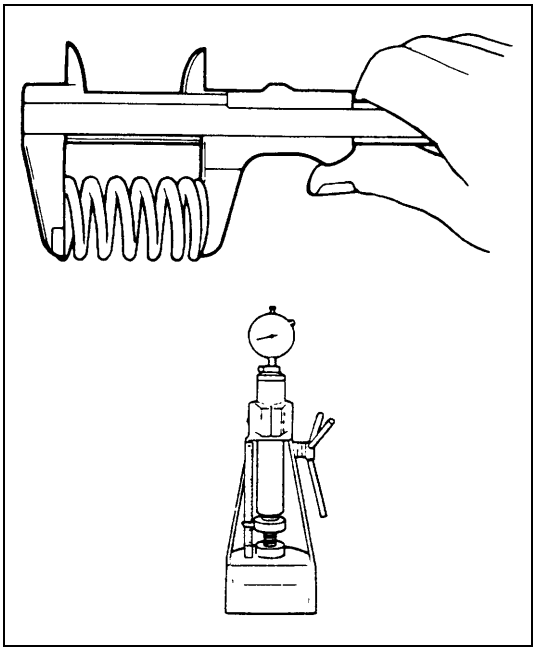
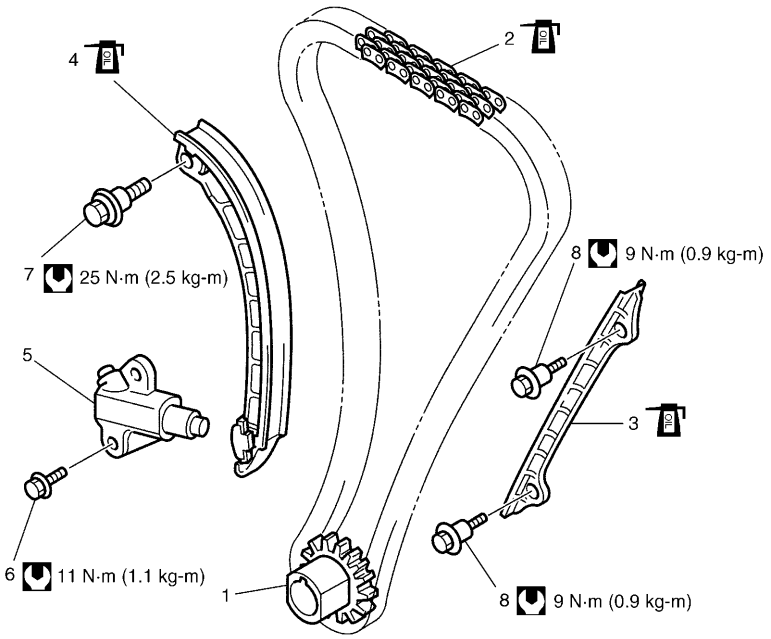


Relief valve spring free length and load

Check relief valve spring free length and load as shown in figure. If the measured valve spring length is lower than the specification, replace relief valve spring.

	Standard	Limit
Free length	52.4 mm (2.06 in.)	–
Load at spring length 38.5 mm (1.52 in.)	77 N (7.7 kgf, 17.0 lb)	69 N (6.9 kgf, 15.0 lb)

Timing Chain and Chain Tensioner Components



1. Crankshaft timing sprocket	4. Timing chain tensioner : Apply engine oil to sliding surface.	7. Chain tensioner mounting bolt
2. Timing chain : Apply engine oil.	5. Timing chain tensioner adjuster assembly	8. Chain guide mounting bolt
3. Timing chain No.1 guide : Apply engine oil to sliding surface.	6. Chain tensioner adjuster mounting bolt	Tightening torque

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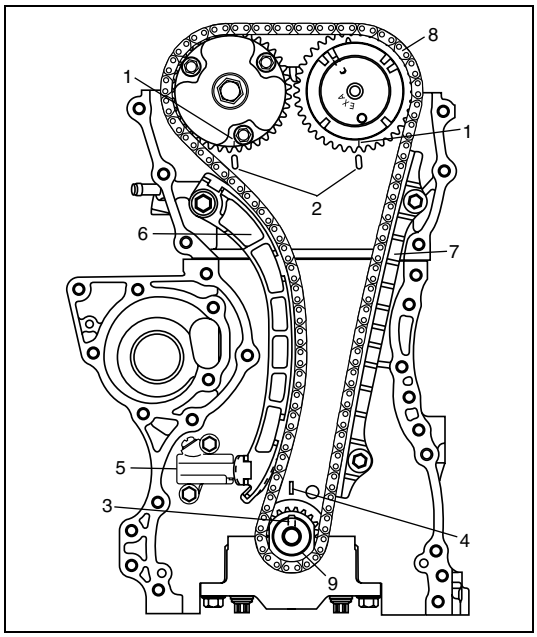
Timing Chain and Chain Tensioner Removal and Installation

Removal

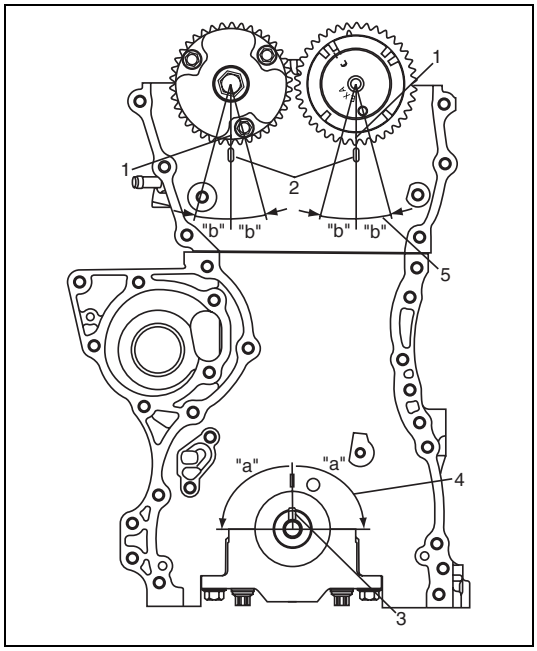
CAUTION:
After removing timing chain, never turn crankshaft and camshafts independently more than its allowable turning range described in "Installation" section.
If turned, interference may occur between piston and valves and valves themselves, and parts related to piston and valves may be damaged.

1) Remove timing chain cover referring to "Timing Chain Cover Removal and Installation" in this section.



2) By turing crankshaft, align both intake and exhaust camshaft timing sprocket marks (1) with notches (2) of cylinder head respectively and align crank shaft sprocket key (3) with notch of cylinder block (4).
3) Remove timing chain tensioner adjuster assembly (5).
4) Remove timing chain tensioner (6).
5) Remove timing chain No.1 guide (7).
6) Remove timing chain (8) with crankshaft timing sprocket (9)

Installation



CAUTION:
After timing chain is removed, never turn crankshaft and camshafts independently more than such an extent ("a", "b") as shown in figure.
If turned, interference may occur between piston and valves and valves themselves, and parts related to piston and valves may be damaged.

1) Check that match marks (1) on intake and exhaust camshaft timing sprockets are in match with notches (2) on cylinder head as shown in figure.
2) Set key (3) and turn crankshaft to position key on upside of crankshaft.

"a" : 90°	4. Crankshaft allowable turning range. By key on crankshaft, within 90° from top on both right and left.
"b" : 15°	5. Camshaft (IN and EX) allowable turning range. By marks on camshaft timing sprocket within 15° from notches on cylinder head on both right and left.

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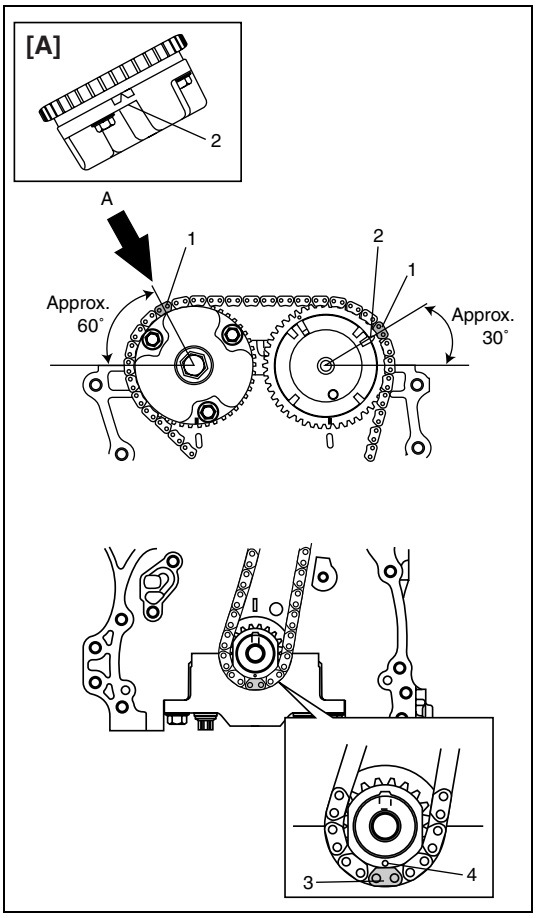
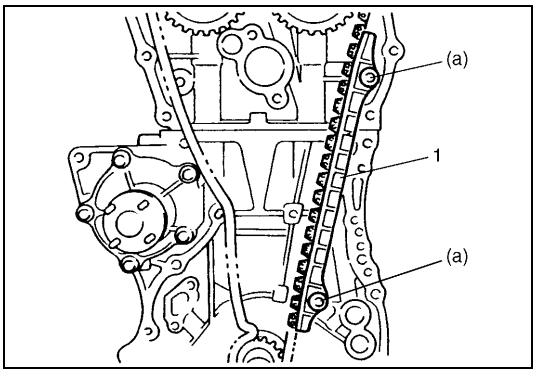


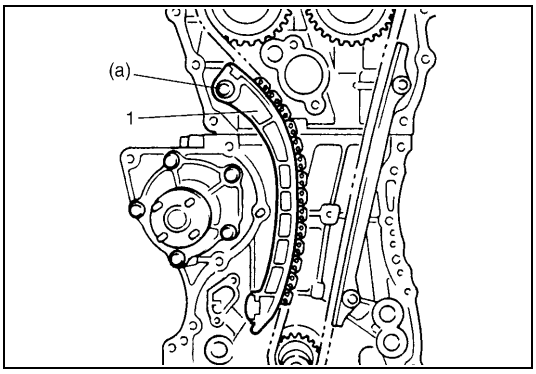
3) Install timing chain by aligning dark blue plate (1) of timing chain and triangle mark (2) on camshaft timing sprocket as shown in figure.
4) Fit crankshaft timing sprocket to timing chain by aligning gold plate (3) of timing chain and circle mark (4) on crankshaft timing sprocket. Then install crankshaft timing sprocket fitted with chain to crankshaft.

[A]: View A



5) Apply engine oil to sliding surface of timing chain No.1 guide (1) and install it as shown in figure.
Tighten guide bolts to specified torque.

Tightening torque
Timing chain No.1 guide bolt
(a): 9 N·m (0.9 kg-m, 6.5 lb-ft)



6) Apply engine oil to sliding surface of chain tensioner (1) and install chain tensioner and spacer.
Tighten tensioner bolt to specified torque

Tightening torque
Timing chain tensioner bolt
(a): 25 N·m (2.5 kg-m, 18.0 lb-ft)

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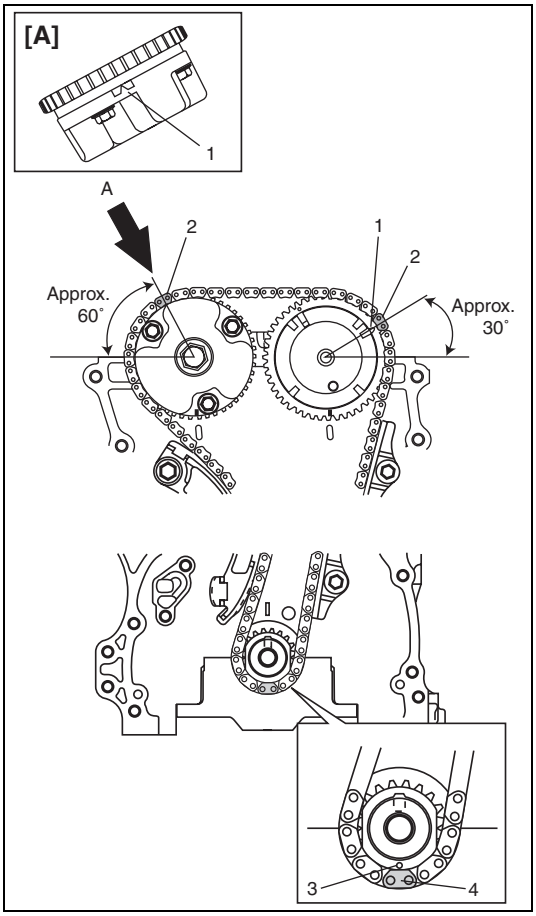
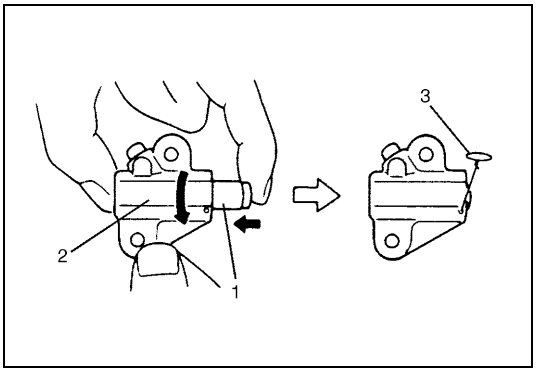
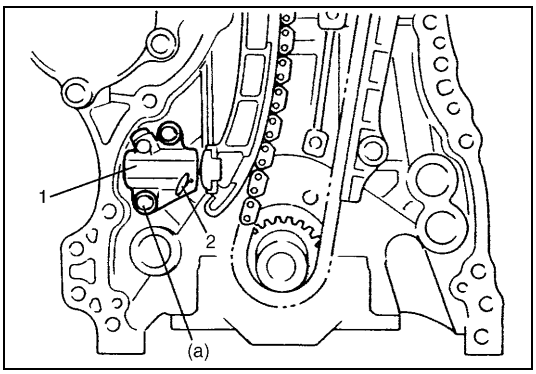


7) Check that match marks (1) on intake and exhaust camshaft timing sprockets are in match with marking of timing chain (2) and match mark on crankshaft timing sprocket (3) are in with marking of timing chain (4).

[A]: View A



8) Screw in plunger (1) by turning body (2) in arrow direction and install a retainer (3) (wire) to hold plunger in place.



9) Install timing chain tensioner adjuster assembly (1) with retainer (2).
Tighten adjuster bolts to specified torque, and then remove retainer from chain tensioner adjuster assembly.

Tightening torque
Timing chain tensioner adjuster bolt
(a): 11 N·m (1.1 kg-m, 8.0 lb-ft)

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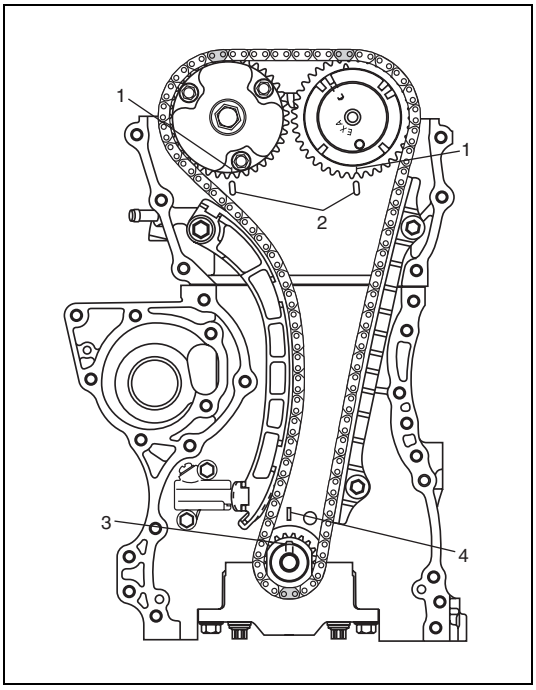
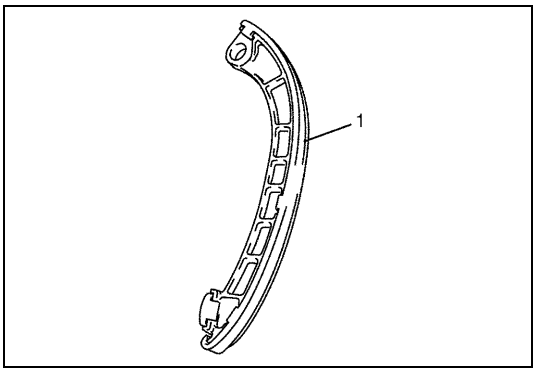


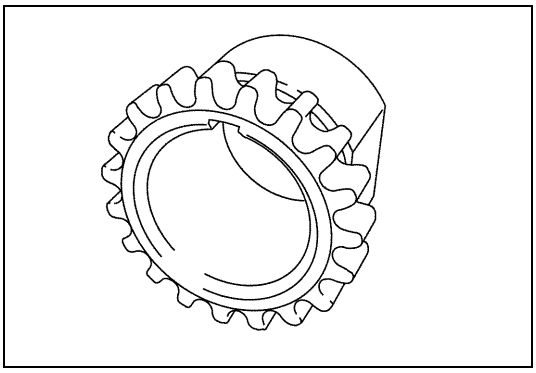
10) Apply engine oil to timing chain and then turn crankshaft clockwise by 2 revolutions and check that match marks (1) on intake and exhaust camshaft timing sprockets are in match with notches (2) on cylinder head and key (3) is in match with notch (4) on cylinder block as shown in figure.
    If each marking chain and each match mark are no matches, adjust each sprockets and timing chain.
11) Install timing chain cover referring to “Timing Chain Cover Removal and Installation” in this section.
12) Perform Steps 3) to 8) of “Installation” of “Timing Chain Cover Removal and Installation” in this section.

Timing Chain and Timing Chain Tensioner Inspection



Timing chain tensioner

- Check shoe (1) for wear or damage.



Crankshaft timing sprocket

- Check teeth of sprocket for wear or damage.

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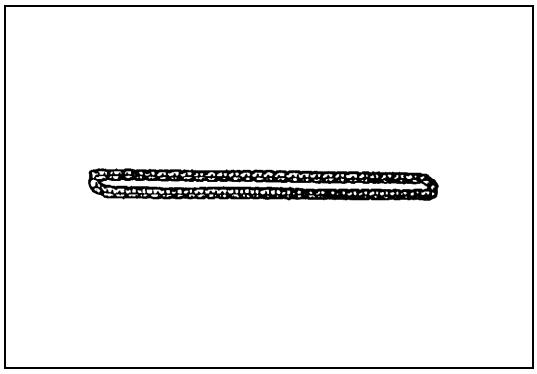
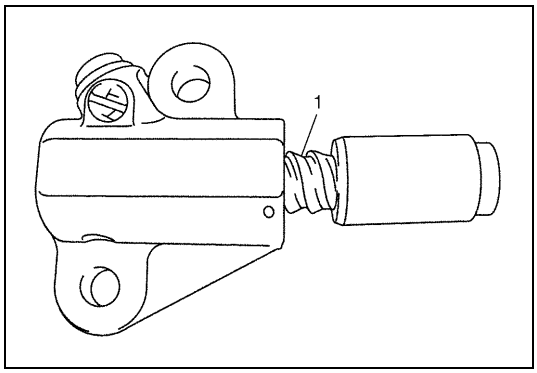


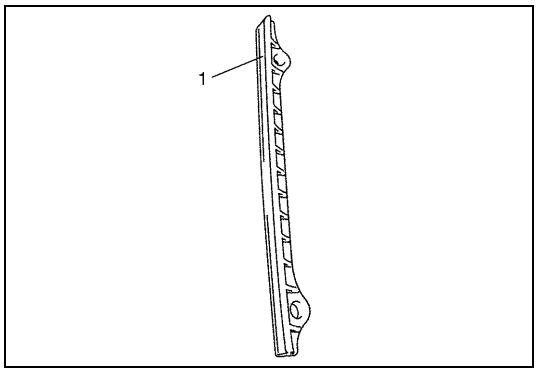
Timing chain

- Check timing chain for wear or damage.



Timing chain tensioner adjuster

- Check that tooth surface (1) are free from damage.



Timing chain No.1 guide

- Check shoe (1) for wear or damage.

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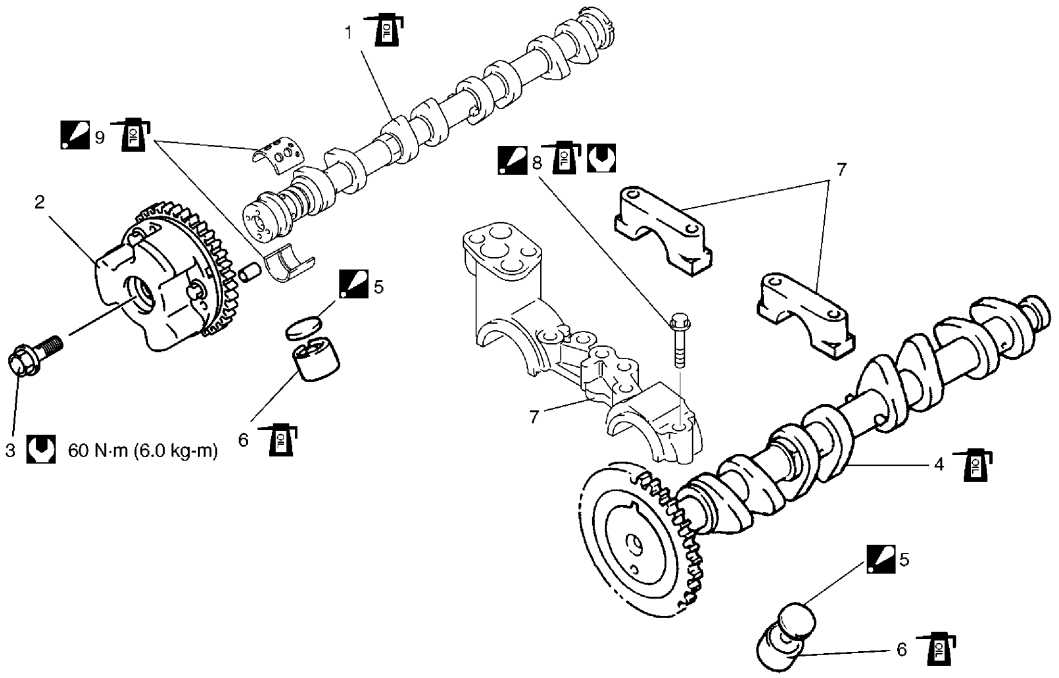
Camshaft, Tappet and Shim Components



1. Intake camshaft	5. Shim : Shim No. on it faces tappet side.	9. Camshaft bearing : Install a bearing half with some holes to upper side of intake camshaft No.1 bearing.
2. Intake camshaft sprocket assembly	6. Tappet	Tightening torque
3. Intake camshaft sprocket bolt	7. Camshaft housing	Apply engine oil to sliding surface of each part.
4. Exhaust camshaft	8. Camshaft housing bolt : Tighten 11 N·m (1.1 kg-m, 8.0 lb-ft) by the specified procedure.	

Camshaft, Tappet and Shim Removal and Installation

Removal

CAUTION:
- **Keep working table, tools and hands clean while overhauling.**
- **Use special care to handle aluminum parts so as not to damage them.**
- **Do not expose removed parts to dust. Keep them always clean.**

1) Remove timing chain cover referring to “Timing Chain Cover Removal and Installation” in this section.
2) Remove timing chain referring to “Timing Chain and Chain Tensioner Removal and Installation” in this section.

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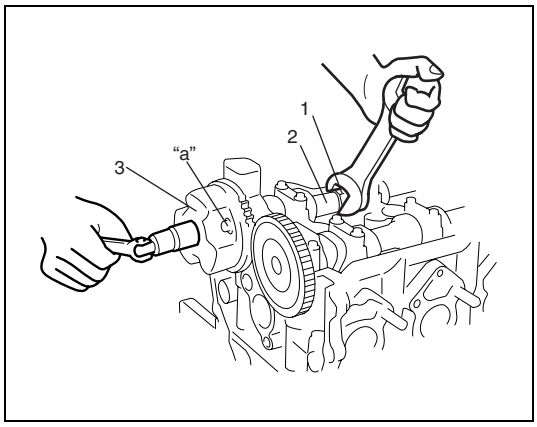
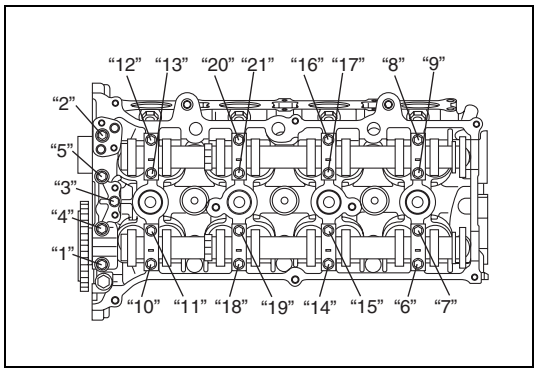
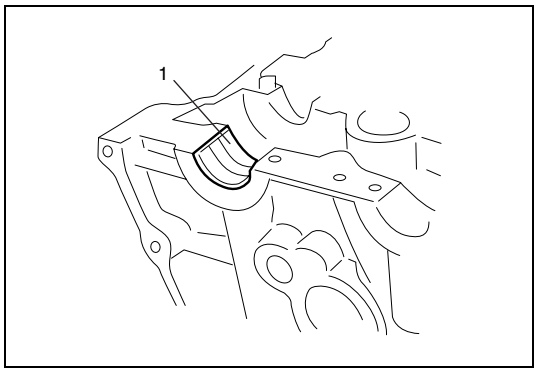


3) With hexagonal section (1) of intake camshaft (2) held stationary with spanner or the like, loosen mounting bolt of intake cam timing sprocket assembly (3) and remove it.

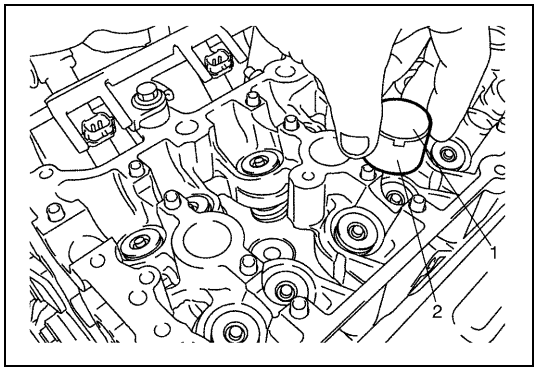
CAUTION:
Never attempt to loosen mounting bolt with intake cam timing sprocket assembly held stationary. Failure to follow this could result in damage to lock pin.
Do not loosen bolt "a" because intake cam timing sprocket assembly is not serviceable.



4) Loosen camshaft housing bolts in such order as indicated in figure and remove them.
5) Remove camshaft housings.
6) Remove intake and exhaust camshafts.



7) Remove camshaft bearing (1).



8) Remove tappets (2) with shims (1).

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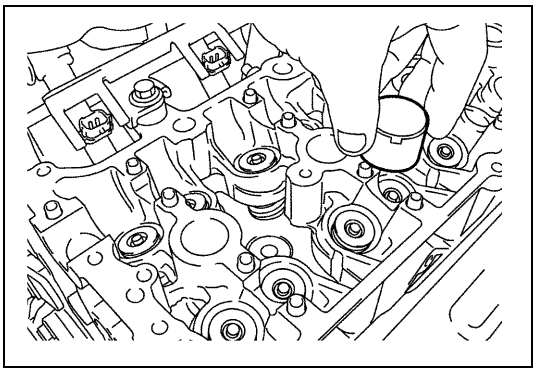
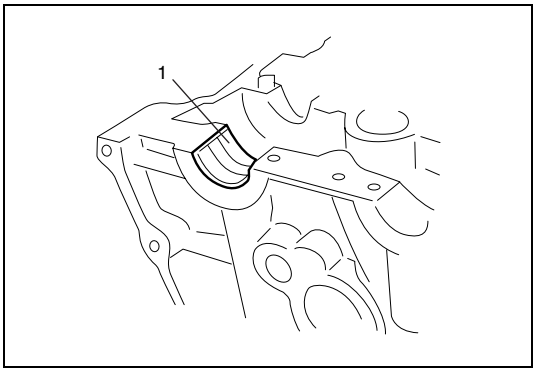
Installation



1) Install tappets and shims to cylinder head.
   Apply engine oil around tappet and then install it to cylinder head.

NOTE:

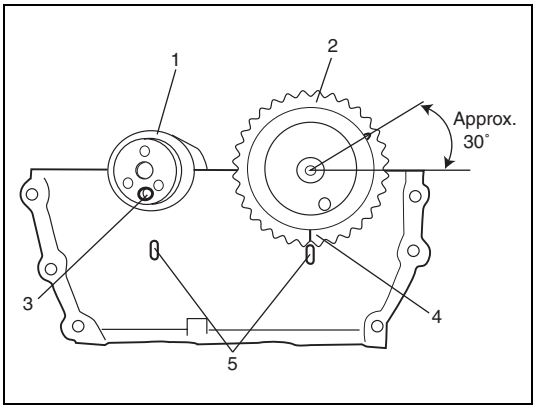
When installing shim, make sure to direct shim No. side toward tappet.



2) Install camshaft bearing (1) to cylinder head.

CAUTION:

Do not apply engine oil to camshaft bearing back.
Only a upper half bearing of intake camshaft bearing No.1 has some holes. Other bearings.

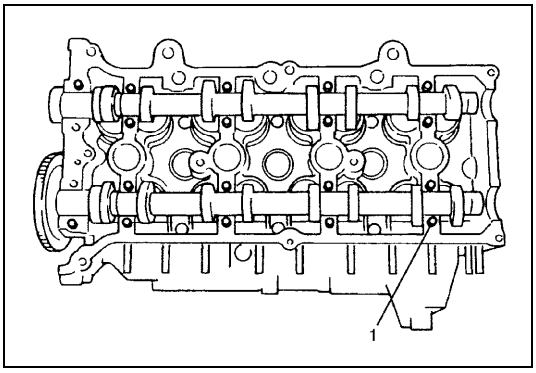


3) Install intake camshaft (1) and exhaust camshaft (2).
   Align knock pin (3) and match mark (4) with notches (5) as shown in the figure.

NOTE:

Before installing camshafts, turn crankshaft until key faces upward. Refer to "Timing Chain and Chain Tensioner".

4) Apply engine oil to sliding surface of each camshaft and camshaft journal then install them as shown in figure.



5) Install camshaft housing pins (1) as shown in figure.

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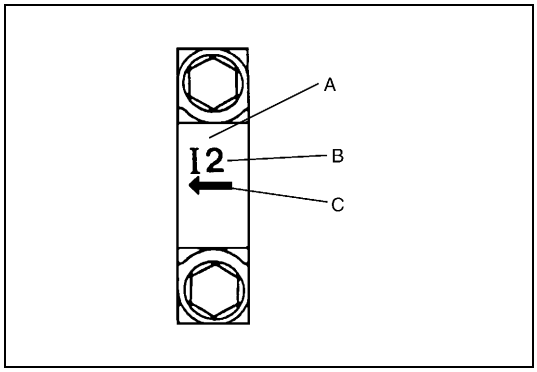
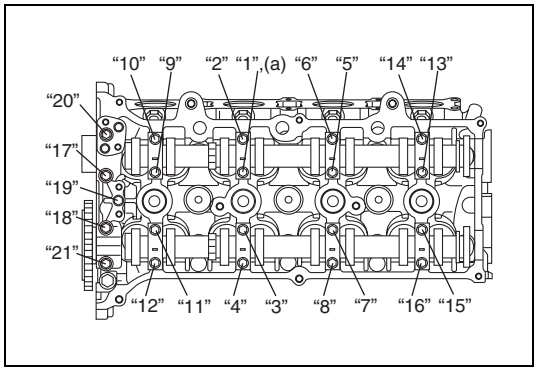


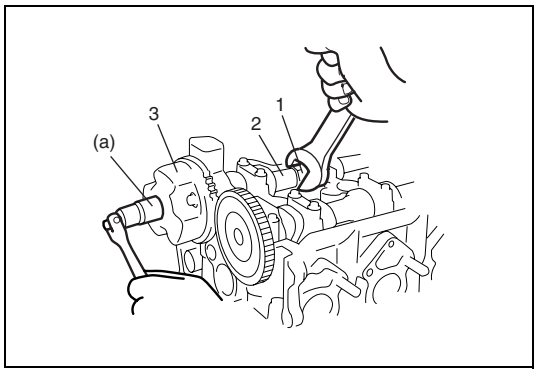
6) Check position of camshaft housings.
Embossed marks are provided on each camshaft housing, indicating position and direction for installation. Install housings as indicated by these marks.

A.	I : Intake side or E : Exhaust side
B.	Position from timing chain side
C.	Pointing to timing chain side



7) After applying engine oil to housing bolts, tighten them temporarily first. Then tighten them by the numerical order in figure. Tighten a little at a time and evenly among bolts and repeat tightening sequence two or three times before they are tightened to specified torque.

Tightening torque
Camshaft housing bolt
(a): Tighten 11 N·m (1.1 kg-m, 8.0 lb-ft)
by the specified procedure

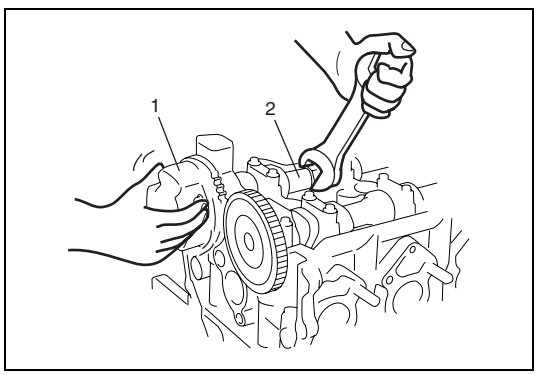


8) With hexagonal section (1) of intake camshaft (2) held stationary with spanner or the like, tighten bolt of intake cam timing sprocket assembly (3) to specification.

Tightening torque
Intake cam timing sprocket bolt
(a): 60 N·m (6.0 kg-m, 43 lb-ft)

9) Install timing chain with crankshaft sprocket referring to "Timing Chain and Chain Tensioner Removal and Installation" in this section.
10) Install timing chain cover referring to "Timing Chain Cover Removal and Installation" in this section.
11) Check valve lashes as previously outlined.
12) Perform Steps 3) to 8) of "Installation" of "Timing Chain Cover Removal and Installation" in this section.

Camshaft, Tappet and Shim Inspection



Intake cam timing sprocket assembly

Fit intake cam timing sprocket assembly to camshaft (2) and hold hexagonal section of camshaft by using spanner or the like.
Check if sprocket (1) is not turned by hand.
If moved, replace intake cam timing sprocket assembly.

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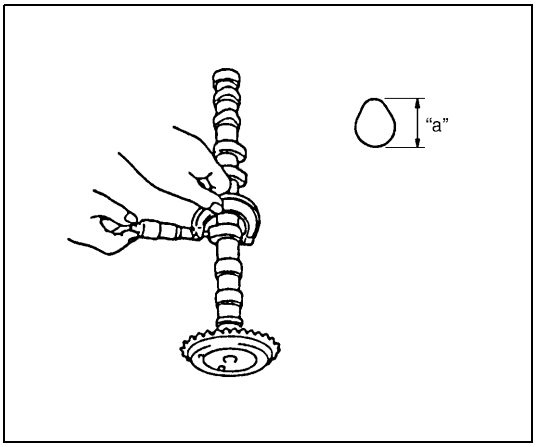
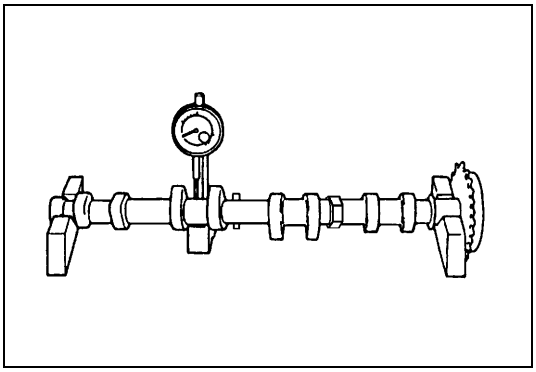


Cam wear

Using a micrometer, measure cam height "a". If measured height underruns its limit, replace camshaft.

Cam height "a" of camshaft

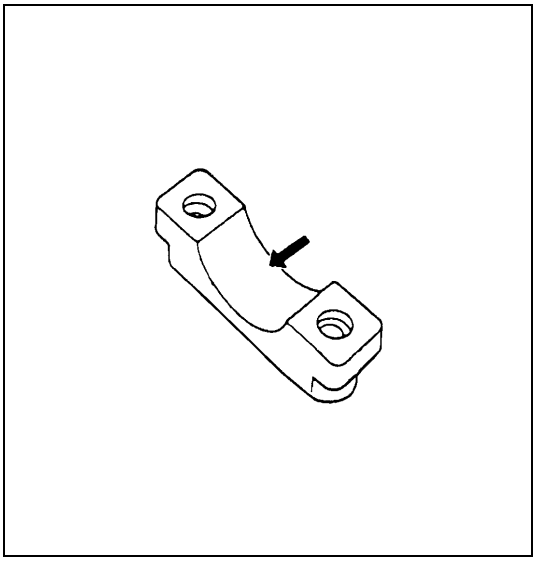
	Standard	Limit
Intake cam	45.420 – 45.580 mm (1.788 – 1.7945 in.)	45.301 mm (1.784 in.)
Exhaust cam	44.399 – 44.559 mm (1.748 – 1.754 in.)	44.280 mm (1.743 in.)



Camshaft runout

Set camshaft between two "V" blocks, and measure its runout by using a dial gauge.
If measured runout exceeds limit, replace camshaft.

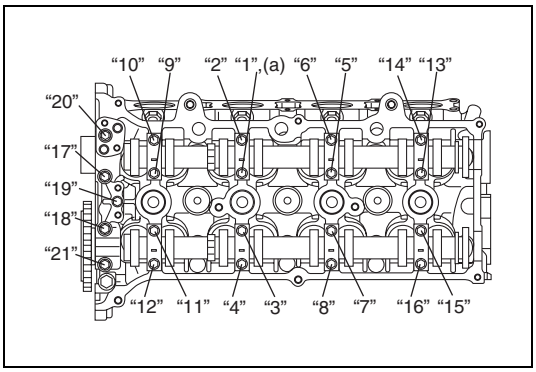
Camshaft runout limit
: 0.10 mm (0.0039 in.)



Camshaft journal wear

Check camshaft journals and camshaft housings for pitting, scratches, wear or damage.
If any malcondition is found, replace camshaft or cylinder head with housing. Never replace cylinder head without replacing housings.
Check clearance by using gaging plastic. Checking procedure is as follows.

1) Clean housings and camshaft journals.
2) Remove all tappets with shims.
3) Install camshafts to cylinder head.
4) Place a piece of gaging plastic to full width of journal of camshaft (parallel to camshaft).
5) Install camshaft housing.



6) Tighten camshaft housing bolts in such order as indicated in figure a little at a time till they are tightened to specified torque.

NOTE:

Do not rotate camshaft while gaging plastic is installed.

Tightening torque
Camshaft housing bolt
(a): Tighten 11 N·m (1.1 kg-m, 8.0 lb-ft)
by the specified procedure

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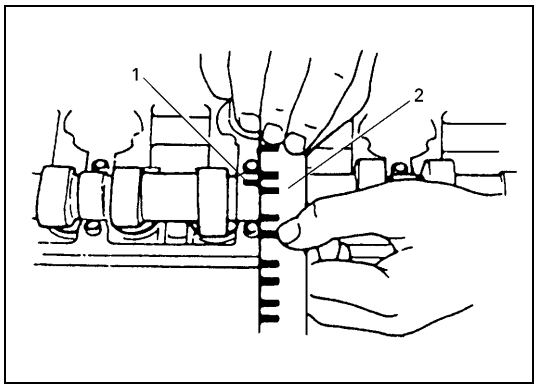
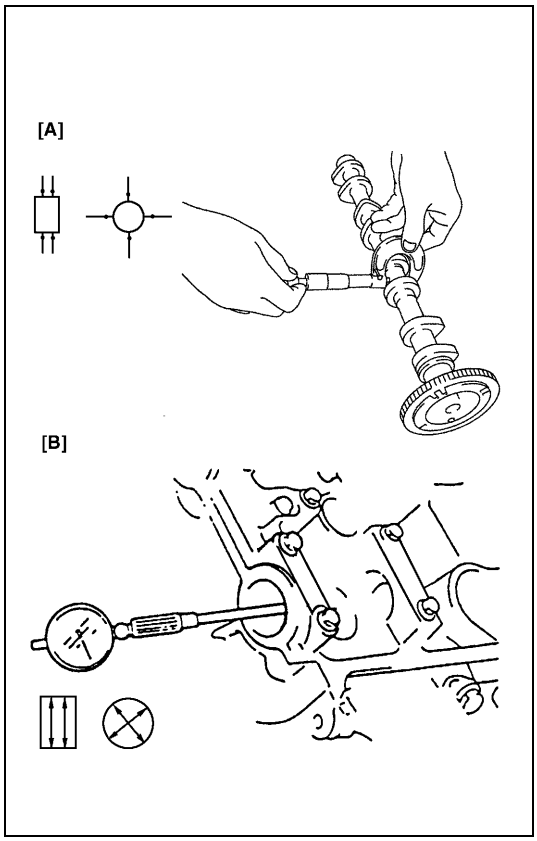


7) Remove housing, and using scale (2) on gaging plastic (1) envelop, measure gaging plastic width at its widest point.

Camshaft journal clearance

	Standard	Limit
Intake side No.1 housing	0.020 – 0.072 mm (0.0008 – 0.0028 in.)	0.10 mm (0.0039 in.)
Others	0.045 – 0.087 mm (0.0018 – 0.0034 in.)	0.12 mm (0.0047 in.)



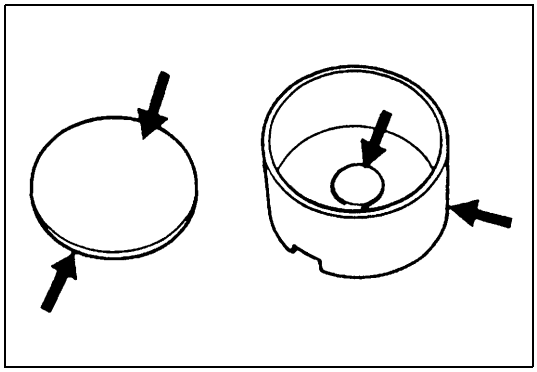
If measured camshaft journal clearance exceeds limit, measure journal (housing) bore and outside diameter of camshaft journal. Replace camshaft or cylinder head assembly whichever the difference from specification is greater.

Camshaft journal diameter [A]

Item	Standard
Intake side No.1 housing	26.940 – 26.955 mm (1.0606 – 1.0612 in.)
Exhaust side No.1 housing	26.934 – 26.955 mm (1.0604 – 1.0612 in.)
Others	22.934 – 22.955 mm (0.9029 – 0.9037 in.)

Camshaft journal bearing bore [B]

Item	Standard
Intake side No.1 housing	–
Exhaust side No.1 housing	27.000 – 27.021 mm (1.0630 – 1.0638 in.)
Others	23.000 – 23.021 mm (0.9055 – 0.9063 in.)



Wear of tappet and shim

Check tappet and shim for pitting, scratches or damage.
If any malcondition is found, replace.

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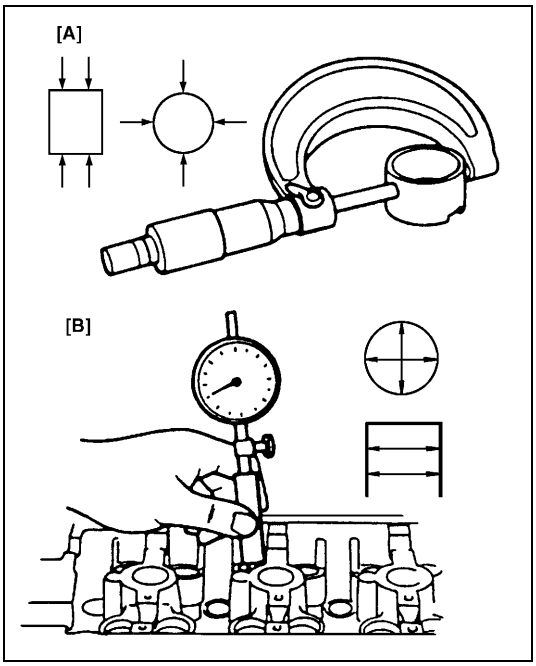

Measure cylinder head bore and tappet outside diameter to determine cylinder head-to-tappet clearance. If clearance exceeds limit, replace tappet or cylinder head.

Cylinder head to tappet clearance
Standard : 0.025 – 0.066 mm (0.0010 – 0.0026 in.)
Limit: 0.15 mm (0.0059 in.)

Tappet outside diameter [A]
Standard: 30.959 – 30.975 mm (1.2189 – 1.2195 in.)

Cylinder head tappet bore [B]
Standard: 31.000 – 31.025 mm (1.2205 – 1.2215 in.)

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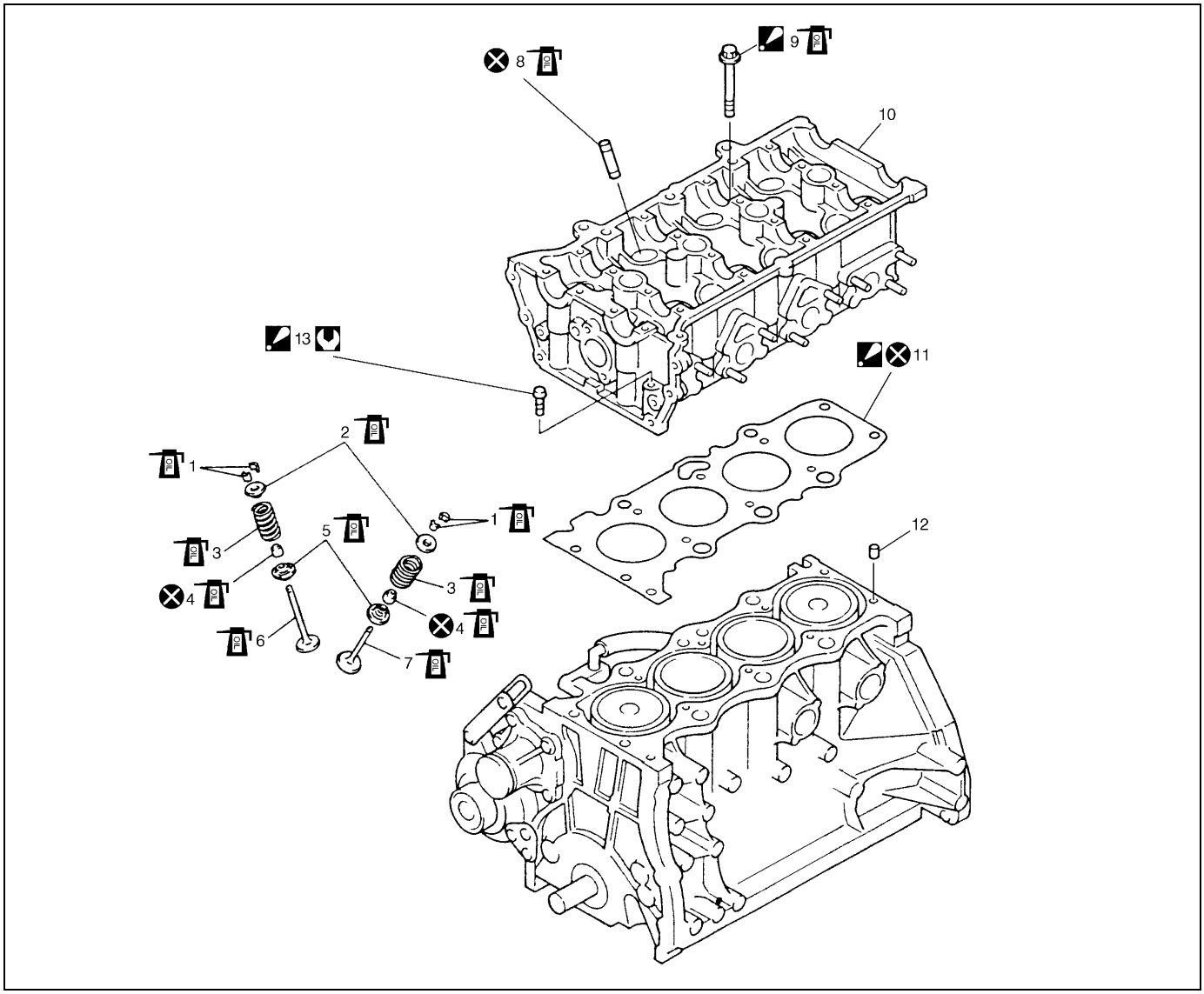
Valves and Cylinder Head Components



1. Valve cotters	7. Exhaust valve	12. Knock pin
2. Valve spring retainer	8. Valve guide	13. Cylinder head bolt (M8) : Tighten 25 N·m (2.5 kg-m, 18.0 lb-ft) by the specified procedure.
3. Valve spring	9. Cylinder head bolt (M10) : Make sure cylinder head bolt (M10) diameter when reuse it due to plastic deformation tightening. Refer to “Valve and Cylinder Head Inspection” in this section. : Tighten 20 N·m (2.0 kg-m, 14.5 lb-ft), 40 N·m (4.0 kg-m, 29.0 lb-ft), 60 ° and 60 ° by the specified procedure.	Tightening torque
4. Valve stem seal	10. Cylinder head	Do not reuse.
5. Valve spring seat	11. Cylinder head gasket : “TOP” mark provided on gasket comes to crankshaft pulley side, facing up.	Apply engine oil to sliding surface of each part.
6. Intake valve		

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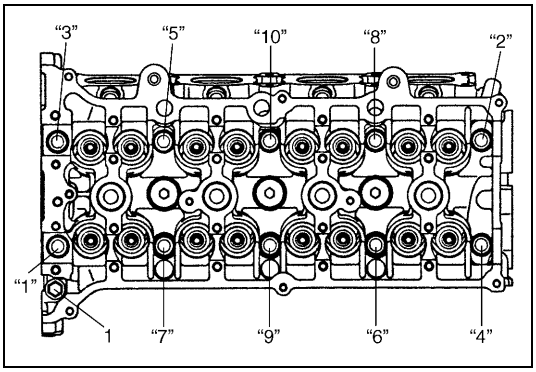
Valves and Cylinder Head Removal and Installation

Removal

1) Remove engine assembly from vehicle referring to “Engine Assembly Removal and Installation” in this section.
2) Remove oil pan referring to “Oil Pan and Oil Pump Strainer Removal and Installation” in this section.
3) Remove cylinder head cover referring to “Cylinder Head Cover Removal and Installation” in this section.
4) Remove timing chain cover referring to Steps 2) to 7) of “Removal” in “Timing Chain Cover Removal and Installation” in this section.
5) Remove timing chain referring to Steps 2) to 6) of “Removal” under “Timing Chain and Chain Tensioner Removal and Installation” in this section.
6) Remove intake and exhaust camshafts referring to Steps 3) to 7) of “Removal” under “Camshaft, Tappet and Shim Removal and Installation” in this section.



7) Loosen cylinder under head bolts in such order as indicated in figure by using a 12 corner socket wrenches and remove them.

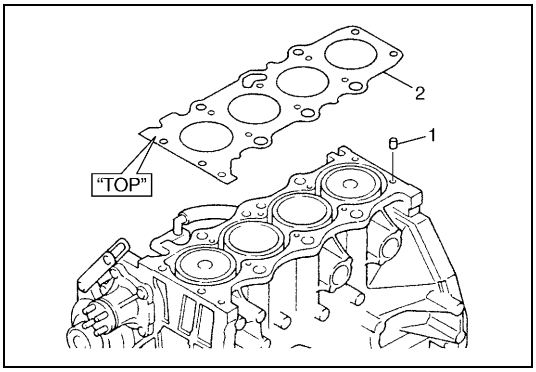
NOTE:

- **Don’t forget to remove bolt (M8) (1) as shown in figure.**
- **Never reuse cylinder head bolts once disassembled it due to plastic deformation tightening. Be sure to use new cylinder head bolts when installing.**

8) Check all around cylinder head for any other parts required to be removed or disconnected and remove or disconnect whatever necessary.
9) Remove exhaust manifold, if necessary, referring to “Exhaust Manifold Removal and Installation” in this section.
10) Remove cylinder head with intake manifold and exhaust manifold. Use lifting device, if necessary.

Installation

1) Clean mating surface of cylinder head and cylinder block. Remove oil, old gasket and dust from mating surface.



2) Install knock pins (1) to cylinder block.
3) Install new cylinder head gasket (2) to cylinder block. “TOP” mark provided on gasket comes to crankshaft pulley side, facing up (toward cylinder head side).

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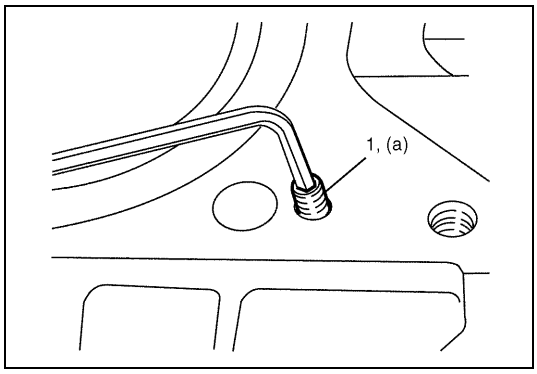
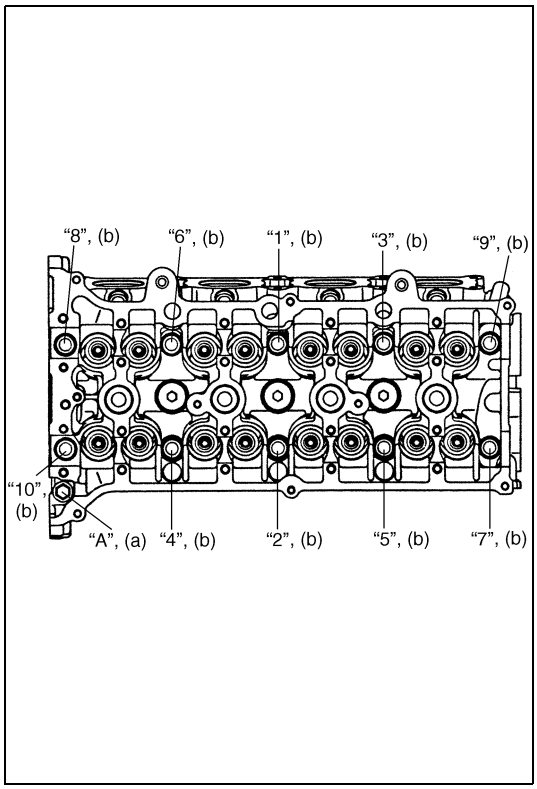


4) Make sure that oil jet (venturi plug) (1) is not clogged.
   If it is not installed, install it as specified torque.

Tightening torque
Venturi plug (a): 5 N·m (0.5 kg-m, 3.5 lb-ft)

5) Check cylinder head bolts (M10) for deformation referring to "Cylinder Head Bolt (M10)" under "Valve and Cylinder Head Inspection" in this section.
   If cylinder head bolt is deformed, use new one in next step.



6) Install cylinder head to cylinder block.
   Apply engine oil to cylinder head bolts and tighten them gradually as follows.
   a) Tighten cylinder head bolts ("1" – "10") to 20 N·m (2.0 kg-m, 14.5 lb-ft) according to numerical order as shown by using a 12 corner socket wrenches.
   b) In the same manner as in Step a), tighten them to 40 N·m (4.0 kg-m, 29.0 lb-ft).
   c) Turn all bolts 60° according to numerical order in figure.
   d) Repeat Step c).
   e) Tighten bolt "A" to specified torque.

NOTE:

Be sure to tighten M8 bolt ("A") after securing the other bolt.

Tightening torque
Cylinder head bolt for M8
(a): Tighten 25 N·m (2.5 kg-m, 18.0 lb-ft)
by the specified procedure
Cylinder head bolt for M10
(b): Tighten 20 N·m (2.0 kg-m, 14.5 lb-ft),
40 N·m (4.0 kg-m, 29.0 lb-ft) 60 ° and 60 °
by the specified procedure

7) Install camshafts, tappet and shim referring to "Camshaft, Tappet and Shim Removal and Installation" in this section.
8) Install timing chain referring to "Timing Chain and Chain Tensioner Removal and Installation" in this section.
9) Install timing chain cover referring to "Timing Chain Cover Removal and Installation" in this section.
10) Install cylinder head cover referring to "Cylinder Head Cover Removal and Installation" in this section.
11) Install oil pan referring to "Oil Pan and Oil Pump Strainer Removal and Installation" in this section.

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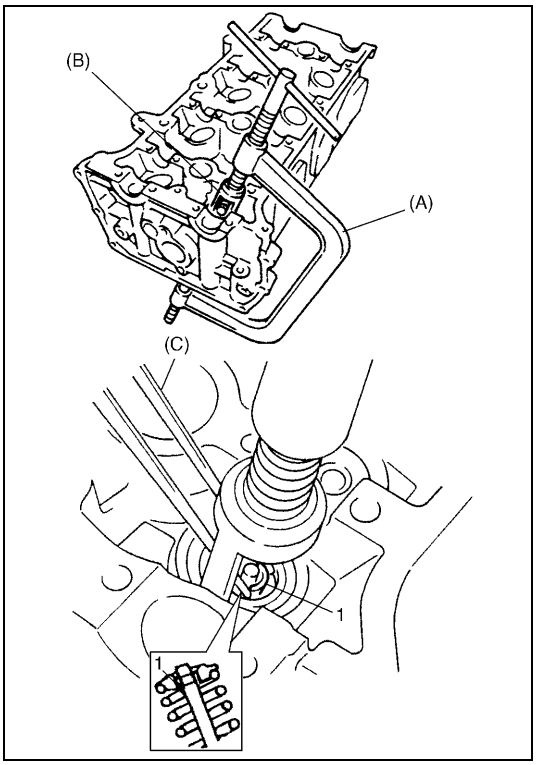
Valves and Cylinder Head Disassembly and Assembly

Disassembly

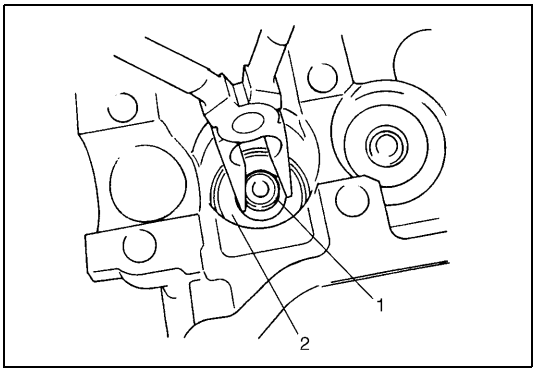
1) For ease in servicing cylinder head, remove intake manifold, injectors and exhaust manifold from cylinder head.



2) Using special tools (valve lifter), compress valve spring and then remove valve cotters (1) by using special tool (forceps).

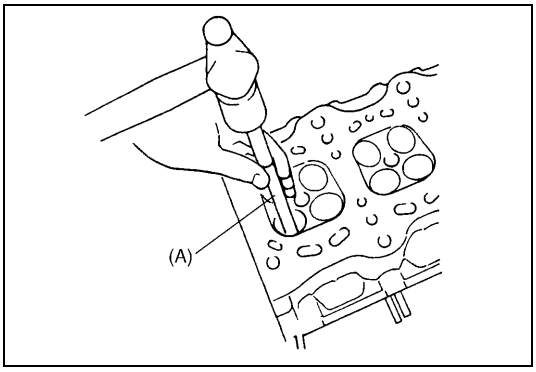
Special tool
(A): 09916-14510
(B): 09916-14521
(C): 09916-84511

3) Release special tools (valve lifter), and remove spring retainer and valve spring.
4) Remove valve from combustion chamber side.



5) Remove valve stem seal (1) from valve guide and valve spring seat (2).

NOTE:
Do not reuse valve stem seal (1) once disassembled. Be sure to use new valve stem seal when assembling.



6) Using special tool (valve guide remover), drive valve guide out from combustion chamber side to valve spring side.

Special tool
(A) : 09916-44910

NOTE:
Do not reuse valve guide once disassembled. Be sure to use new valve guide (oversize) when assembling.

7) Place disassembled parts except valve stem seal and valve guide in order so that they can be installed in their original position.

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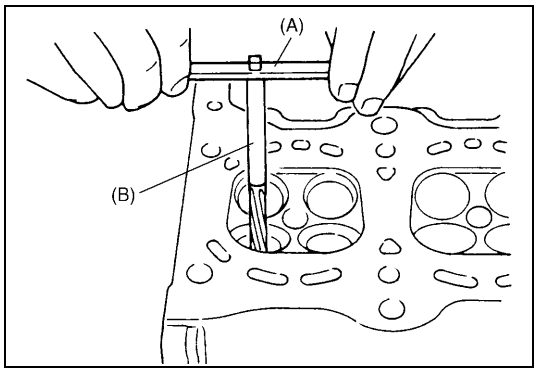
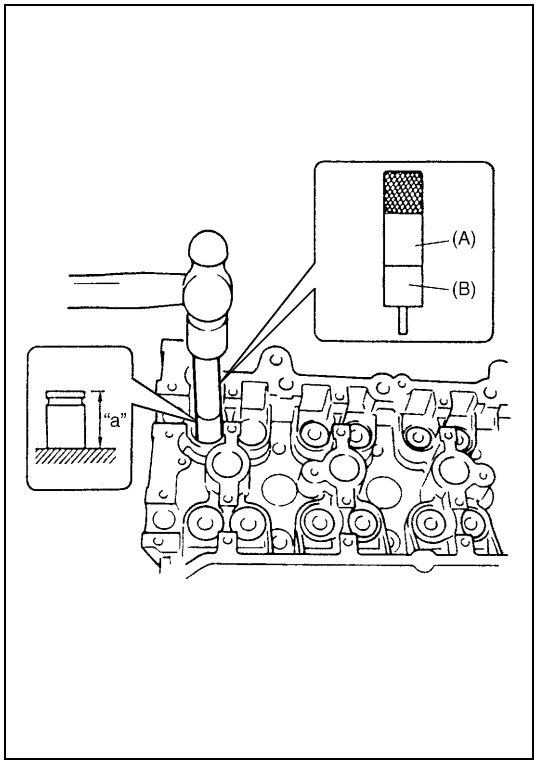
Assembly



1) Before installing valve guide into cylinder head, ream guide hole with special tool (10.5 mm reamer) so as to remove burrs and make it truly round.

Special tool
(A): 09916-34542
(B): 09916-37320



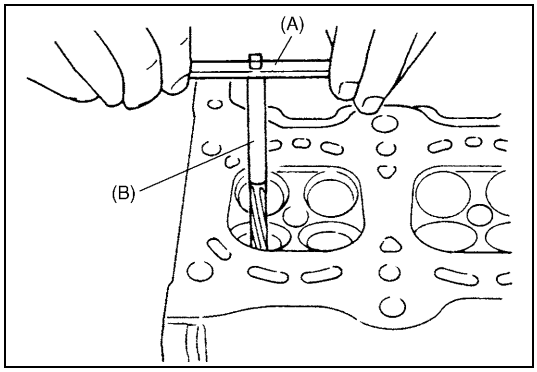
2) Install valve guide to cylinder head.
Heat cylinder head uniformly to a temperature of 80 to 100 °C (176 to 212 °F) so that head will not be distorted, and drive new valve guide into hole with special tools. Drive in new valve guide until special tool (Valve guide installer) contacts cylinder head.
After installing, make sure that valve guide protrudes by specified dimension "a" from cylinder head.

Special tool
(A): 09916-58210
(B): 09916-56011

NOTE:

- **Never reuse once-disassembled valve guide. Make sure to install new valve guide.**
- **Intake and exhaust valve guides are identical.**

Specification for valve guide protrusion "a"
Intake side: 11.3 mm (0.44 in.)
Exhaust side: 11.3 mm (0.44 in.)



3) Ream valve guide bore with special tool (5.5 mm reamer). After reaming, clean bore.

Special tool
(A): 09916-34542
(B): 09916-34550

4) Install valve spring seat to cylinder head.

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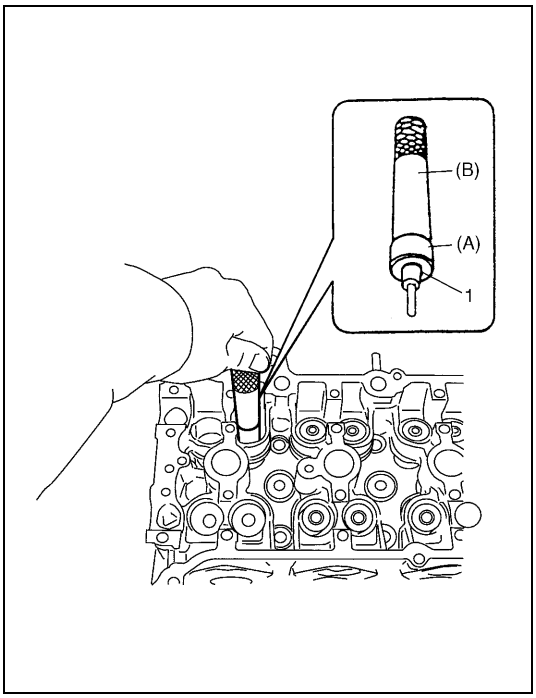
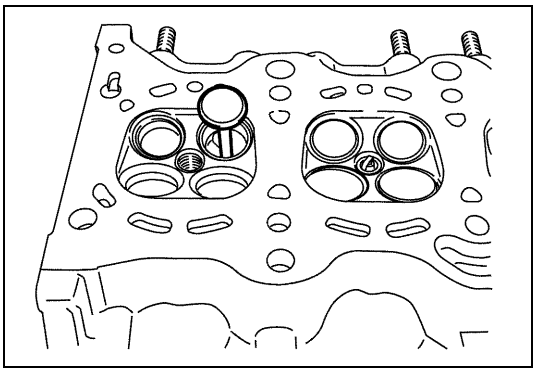


5) Install new valve stem seal (1) to valve guide.
After applying engine oil to seal and spindle of special tool (Valve guide installer handle), fit oil seal to spindle, and then install seal to valve guide by pushing special tool by hand.
After installing, check to be sure that seal is properly fixed to valve guide.

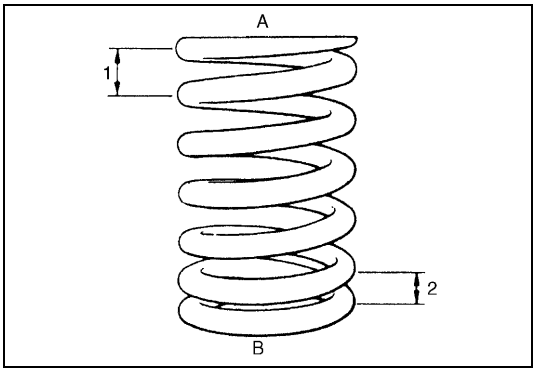
Special tooll
(A): 09916-58210
(B): 09917-98221

NOTE:

- **Do not reuse once-disassembled seal. Be sure to install new seal.**
- **When installing, never tap or hit special tool with a hammer or else. Install seal to guide only by pushing special tool by hand. Tapping or hitting special tool may cause damage to seal.**

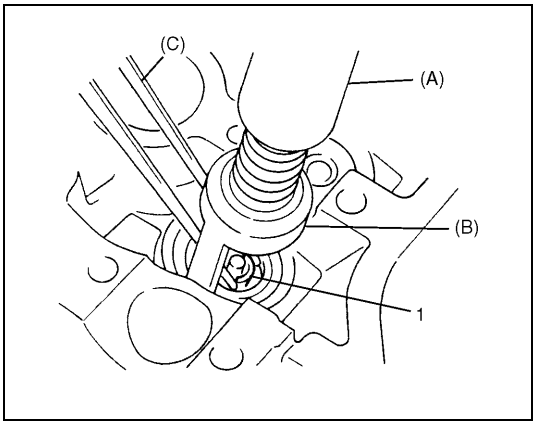


6) Install valve to valve guide.
Before installing valve to valve guide, apply engine oil to stem seal, valve guide bore and valve stem.



7) Install valve spring and spring retainer.
Each valve spring has top end (large-pitch end (1)) and bottom end (small-pitch end (2)). Be sure to position spring in place with its bottom end (small-pitch end) facing the bottom (valve spring seat side).

A :	Valve spring retainer side
B :	Valve spring seat side



8) Using special tools (Valve lifter), compress valve spring and fit two valve cotters (1) into groove in valve stem.

Special tool
(A): 09916-14510
(B): 09916-14521
(C): 09916-84511

NOTE:

When compressing the valve spring, be carefully to free from damage in inside face of tappet installing hole.

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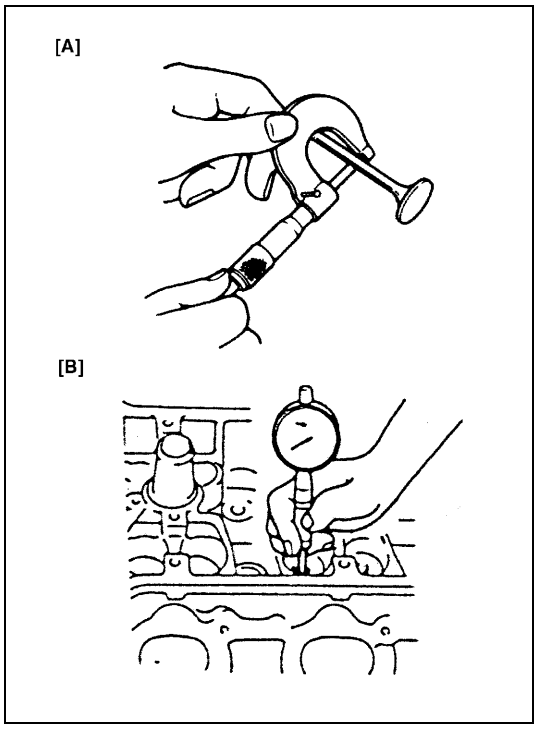
9) Install intake manifold referring to “Intake Manifold Removal and Installation” in this section.
10) Install fuel injectors referring to “Fuel Injector Removal and Installation” in Section 6E1.
11) Install exhaust manifold referring to “Exhaust Manifold Removal and Installation” in this section.

Valves and Cylinder Head Inspection

Valve guides

Valve stem-to-guide clearance



Using a micrometer and bore gauge, take diameter readings on valve stems and guides to check stem-to-guide clearance. Be sure to take reading at more than one place along the length of each stem and guide.
If clearance exceeds limit, replace valve and valve guide.

Valve stem-to-guide clearance

Item	Standard	Limit
In	0.020 – 0.047 mm (0.0008 – 0.0018 in.)	0.07 mm (0.0028 in.)
Ex	0.045 – 0.072 mm (0.0017 – 0.0028 in.)	0.09 mm (0.0035 in.)

Valve stem diameter [A] standard
In: 5.465 – 5.480 mm (0.2150 – 0.2157 in.)
Ex: 5.440 – 5.455 mm (0.2142 – 0.2148 in.)

Valve guide bore [B] standard
In and Ex: 5.500 – 5.512 mm (0.2165 – 0.2170 in.)

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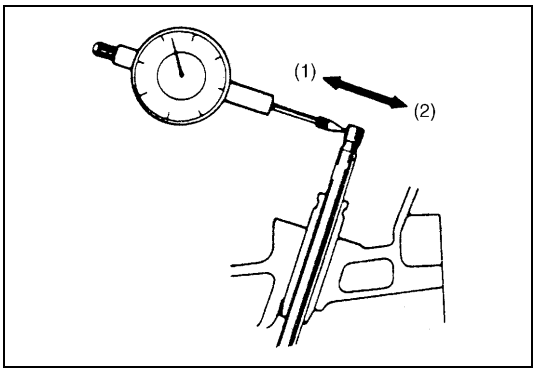
Valve stem end deflection



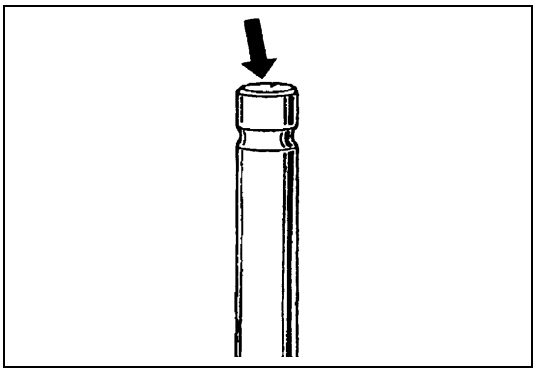
If bore gauge is not available, check end deflection of valve stem with a dial gauge instead.
Move stem end in directions (1) and (2) to measure end deflection.
If deflection exceeds its limit, replace valve stem and valve guide.

Valve stem end deflection limit
In : 0.14 mm (0.005 in.)
Ex : 0.18 mm (0.007 in.)

Valves

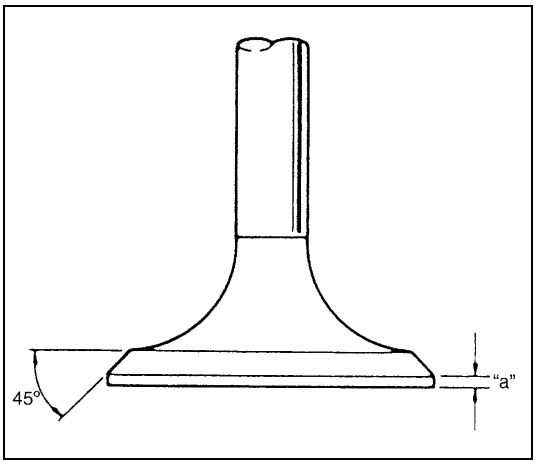
Visual inspection

- Remove all carbon from valves.
- Inspect each valve for wear, burn or distortion at its face and stem end, as necessary, replace it.



- Inspect valve stem end face for pitting and wear. If pitting or wear is found there, valve stem end may be resurfaced, but not too much to grind off its chamber. When it is worn out too much that its chamber is gone, replace valve.

Valve head thickness



Measure thickness “a” of valve head. If measured thickness exceeds limit, replace valve.

Valve head thickness “a” (In and Ex)
Standard : 1.25 – 1.55 mm (0.049 – 0.061 in.)
Limit : 0.9 mm (0.035 in.)

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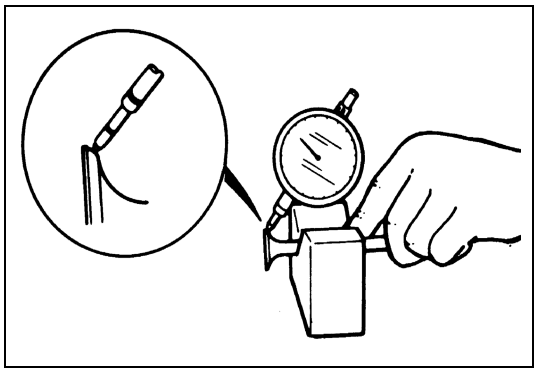
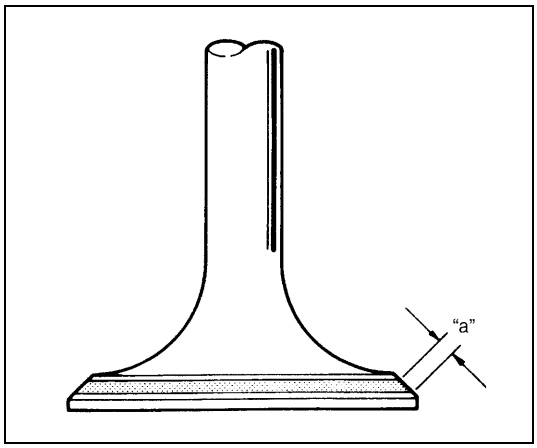
Valve head radial runout



Check each valve for radial runout with a dial gauge and "V" block. To check runout, rotate valve slowly. If runout exceeds its limit, replace valve.

Limit on valve head radial runout
0.08 mm (0.003 in.)

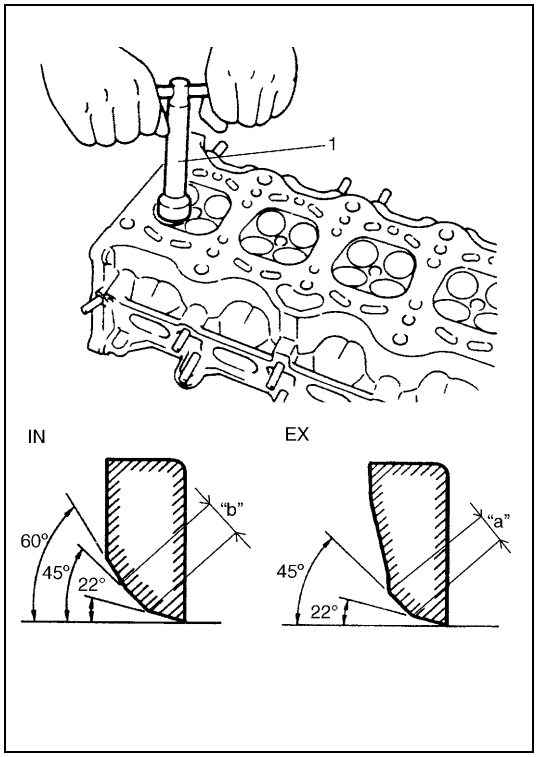
Seating contact width



Create contact pattern on each valve in the usual manner, i.e. by giving uniform coat of marking compound to valve seat and by rotatingly tapping seat with valve head. Valve lapper (tool used in valve lapping) must be used.
Pattern produced on seating face of valve must be a continuous ring without any break, and the width of pattern must be within specified range.

Standard seating width "a" revealed by contact pattern on valve face
In and Ex: 1.0 - 1.4 mm (0.0389 - 0.0551 in.)

Valve seat repair



A valve seat not producing a uniform contact with its valve or showing width of seating contact that is out of specified range must be repaired by regrinding or by cutting and regrinding and finished by lapping.

1) EXHAUST VALVE SEAT: Use valve seat cutters (1) to make two cuts as illustrated in figure. Two cutters must be used: the first for making 22° angle, and the second for making 45° angle. The second cut must be made to produce desired seat width.

   Seat width for exhaust valve seat
   "a": 1.0 – 1.4 mm (0.0389 – 0.0551 in.)

2) INTAKE VALVE SEAT: Use valve seat cutters (1) to make three cuts as illustrated in figure. Three cutters must be used: the 1st for making 15° angle, the 2nd for making 60° angle, and 3rd for making 45° angle. The 3rd cut (45°) must be made to produce desired seat width.

   Seat width for intake valve seat
   "b": 1.0 – 1.4 mm (0.0389 – 0.0551 in.)

3) VALVE LAPPING: Lap valve on seat in two steps, first with coarse size lapping compound applied to face and the second with fine-size compound, each time using valve lapper according to usual lapping method.

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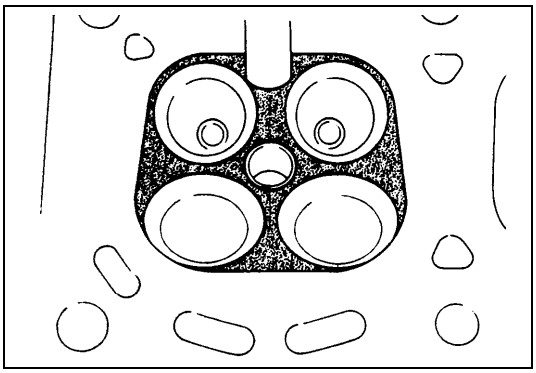
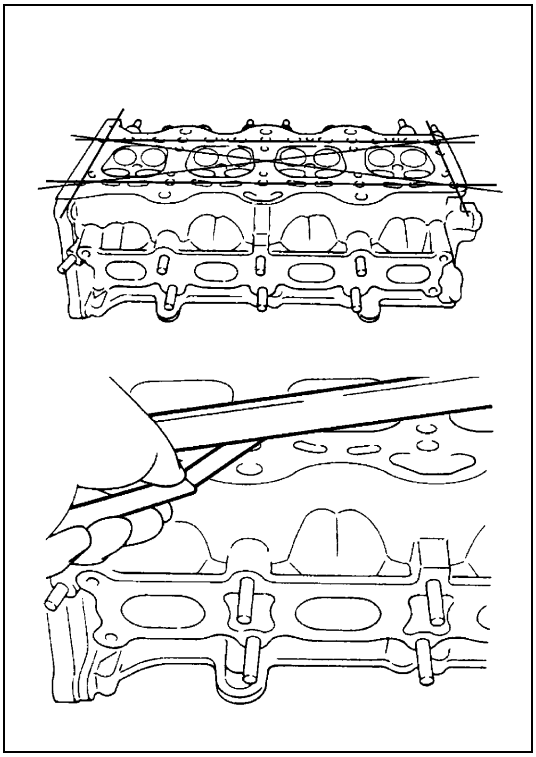


Cylinder head

- Remove all carbon deposits from combustion chambers.

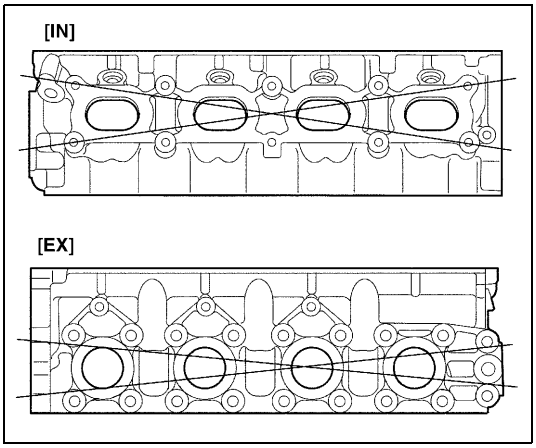
NOTE:

Do not use any sharp-edged tool to scrape off carbon deposits. Be careful not to scuff or nick metal surfaces when decarbonizing. The same applies to valves and valve seats, too.



- Check cylinder head for cracks on intake and exhaust ports, combustion chambers, and head surface.
  Using a straightedge and thickness gauge, check flatness of gasketed surface at a total of 6 locations. If distortion limit, given below, is exceeded, correct gasketed surface with a surface plate and abrasive paper of about #400 (Waterproof silicon carbide abrasive paper): place abrasive paper on and over surface plate, and rub gasketed surface against paper to grind off high spots. Should this fail to reduce thickness gauge readings to within limit, replace cylinder head.
  Leakage of combustion gases from this gasketed joint is often due to warped gasketed surface: such leakage results in reduced power output.

Limit of distortion for cylinder head surface on piston side : 0.03 mm (0.001 in.)



- Distortion of manifold seating faces:
  Check seating faces of cylinder head for manifolds, using a straightedge and thickness gauge, in order to determine whether these faces should be corrected or cylinder head replaced.

Limit of distortion for cylinder head surface on intake and exhaust manifold
0.05 mm (0.002 in.)

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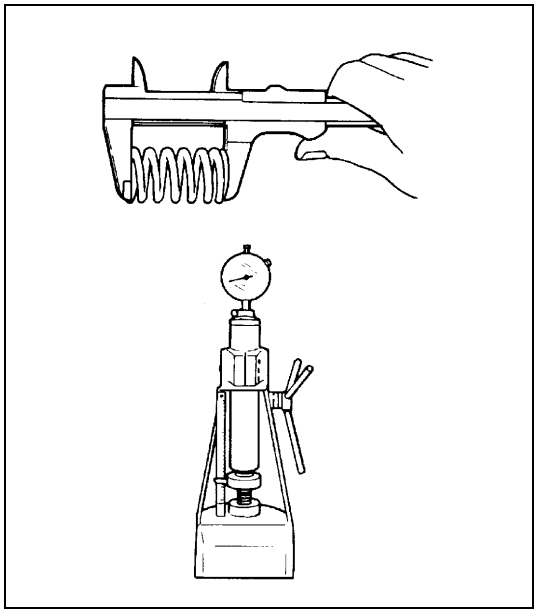
Valve springs

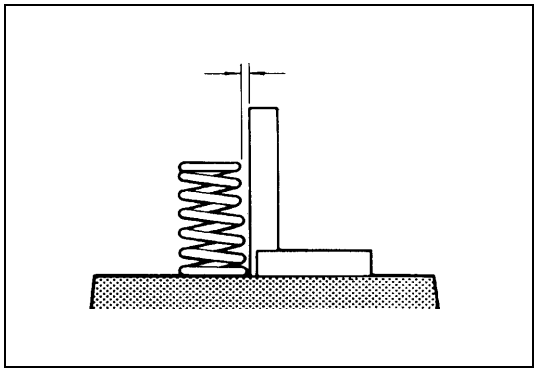


Valve spring free length and preload

Referring to data given below, check to be sure that each spring is in sound condition, free of any evidence of breakage or weakening. Remember, weakened valve springs can cause chatter, not to mention possibility of reducing power output due to gas leakage caused by decreased seating pressure.

Valve spring free length
Standard: 36.83 mm (1.450 in.)
Limit: 35.83 mm (1.411 in.)

Valve spring preload
Standard: 107 – 125 N (10.7 – 12.5 kg) for 31.50 mm (23.6 – 27.6 lb/1.240 in.)
Limit: 102 N (10.2 kg) for 31.5 mm (22.5 lb/1.240 in.)

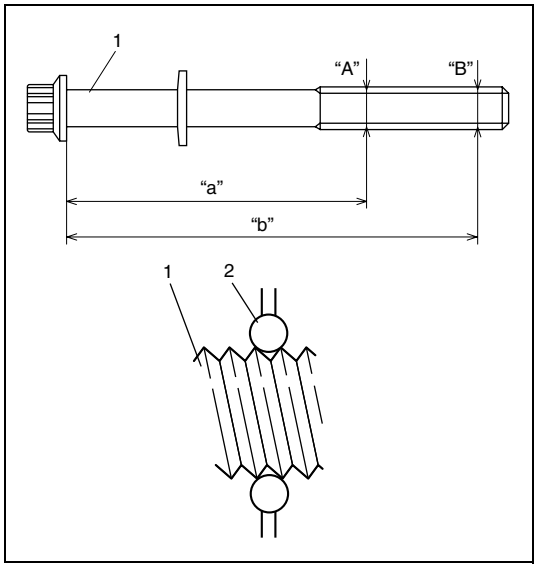


Spring squareness

Use a square and surface plate to check each spring for squareness in terms of clearance between end of valve spring and square. Valve springs found to exhibit a larger clearance than limit given below must be replaced.

Valve spring squareness limit
1.6 mm (0.079 in.)

Cylinder head bolt (M10)



Check cylinder head bolt (1) for deformation as follows.
If thread diameter difference exceeds limit, replace cylinder head bolt with new one.

1) Measure thread diameter "A" and "B" of cylinder head bolt (1) by using a micrometer (2).
2) Calculate difference in diameters ("A" – "B").

Cylinder head bolt diameter measurement points
"a": 83.5 mm (2.81 in.)
"b": 115 mm (4.53 in.)
Cylinder head bolt diameter difference (deformation)
Limit ("A" – "B"): 0.1 mm (0.004 in.)

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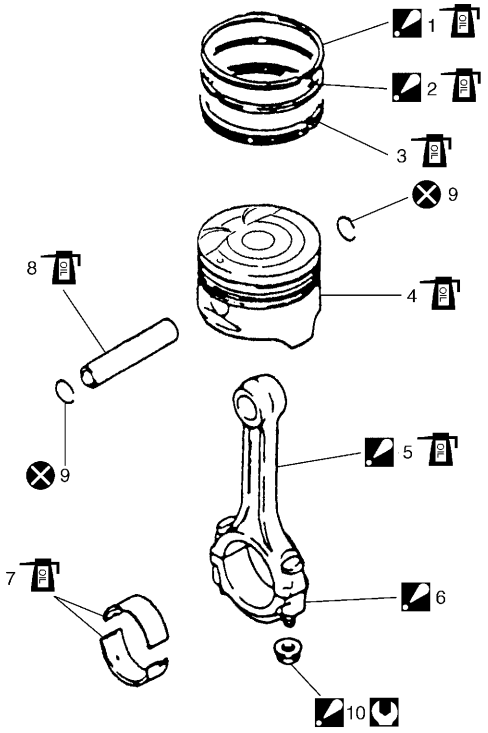
Pistons, Piston Rings, Connecting Rods and Cylinders Components



		7.	Connecting rod bearing
◢	1. Top ring : “T” mark side of piston ring to piston top side. : 1st ring differs from 2nd ring in thickness, shape and color of surface contacting cylinder wall. Install spacer and then two rails.	8.	Piston pin
◢	2. 2nd ring : “T” mark side of piston ring to piston top side. : 1st ring differs from 2nd ring in thickness, shape and color of surface contacting cylinder wall. Install spacer and then two rails.	9.	Piston pin circlip
	3. Oil ring : Install spacer and then two rails.	◢	10. Bearing cap nut : Tighten 15 N·m (1.5 kg-m, 11.0 lb-ft), 45 ° and 45 ° by specified procedure.
	4. Piston		Tightening torque
◢	5. Connecting rod : Apply engine oil to sliding surface except inner surface of big end, and rod bolts. Make sure rod bolt diameter when reuse it due to plastic deformation tightening. Refer to “Inspection” of “Connecting Rod”.		Apply engine oil to sliding surface of each parts.
◢	6. Connecting rod bearing cap : Point arrow mark on cap to crankshaft pulley side.		Do not reuse.

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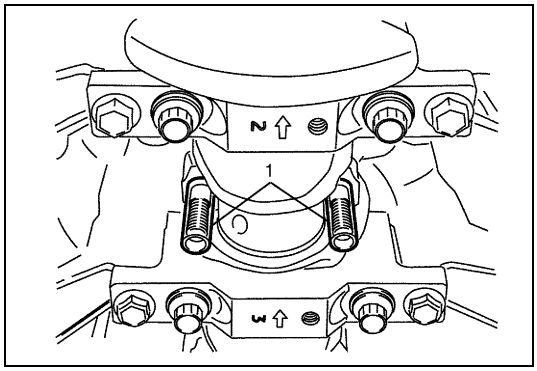
Pistons, Piston Rings, Connecting Rods and Cylinders Removal and Installation

Removal

1) Remove engine assembly from vehicle referring to “Engine Assembly Removal and Installation” in this section.
2) Remove cylinder head referring to “Valves and Cylinder Head Removal and Installation”.
3) Mark cylinder number on all pistons, connecting rods and connecting rod caps using silver pencil or quick drying paint.
4) Remove rod bearing caps.



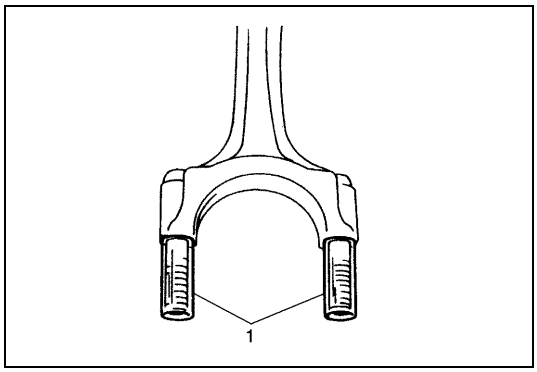
5) Install guide hose (1) over threads of rod bolts.
   This prevents damage to bearing journal and rod bolt threads when removing connecting rod.
6) Decarbonize top of cylinder bore before removing piston from cylinder.
7) Push piston and connecting rod assembly out through the top of cylinder bore.

Installation

1) Check connecting rod bolts for deformation referring to “Connecting Rod Bolt Deformation” under “Pistons, Piston rings, connecting Rods and Cylinders Inspection” in this section.
   If connecting rod bolt is deformed, use new connecting rod in next step.
2) Apply engine oil to pistons, rings, cylinder walls, connecting rod bearings and crank pins.

NOTE:

Do not apply oil between connecting rod and bearing or between bearing cap and bearing.



3) Install guide hoses (1) over connecting rod bolts.
   These guide hoses protect crank pin and threads of rod bolt from damage during installation of connecting rod and piston assembly.

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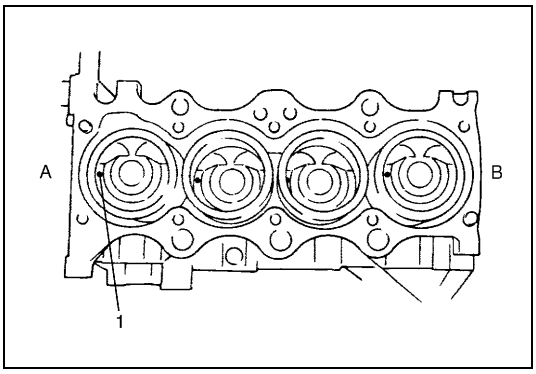
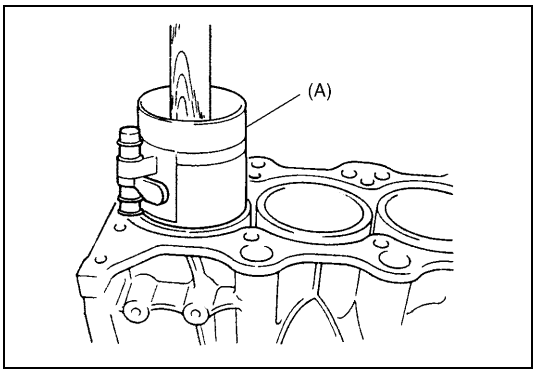


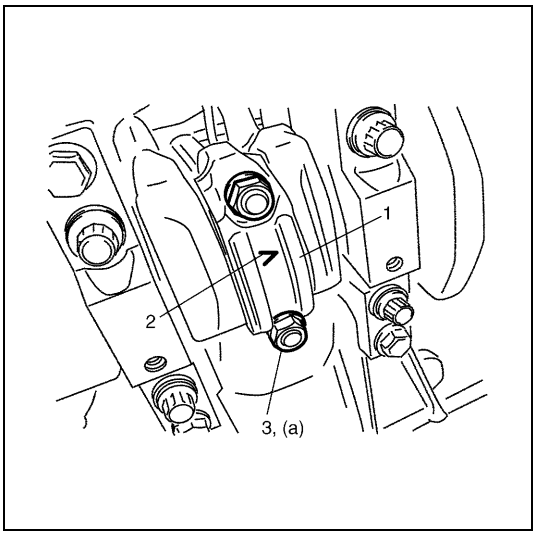
4) When installing piston and connecting rod assembly into cylinder bore, point front mark (1) on piston head to crankshaft pulley side.

A :	Crankshaft pulley side
B :	Flywheel side



5) Install piston and connecting rod assembly into cylinder bore. Use special tool (Piston ring compressor) to compress rings. Guide connecting rod into place on crankshaft.
Using a hammer handle, tap piston head to install piston into bore. Hold ring compressor firmly against cylinder block until all piston rings have entered cylinder bore.

Special tool
(A): 09916-77310



6) Install bearing cap (1):
Point arrow mark (2) on cap to crankshaft pulley side.
After applying oil to rod bolts and tighten cap nuts (3) gradually as follows.
a) Tighten all cap nuts to 15 N·m (1.5 kg-m, 11.0 lb-ft).
b) Retighten them to 45 °.
c) Repeat Step b) once again.

Tightening torque
Connecting rod bearing cap nuts
(a): Tighten 15 N·m (1.5 kg-m, 11.0 lb-ft), 45 ° and 45 ° by the specified procedure

7) Install cylinder head referring to “Valves and Cylinder Head Removal and Installation” in this section.

Pistons, Piston Rings, Connecting Rods and Cylinders Disassembly and Assembly

Disassembly

1) Using piston ring expander, remove two compression rings (Top and 2nd) and oil ring from piston.
2) Remove piston pin from connecting rod as follows.

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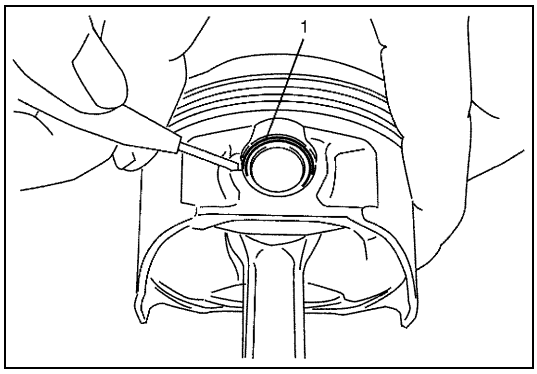
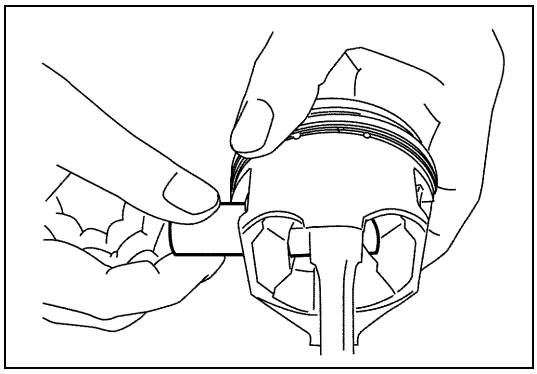


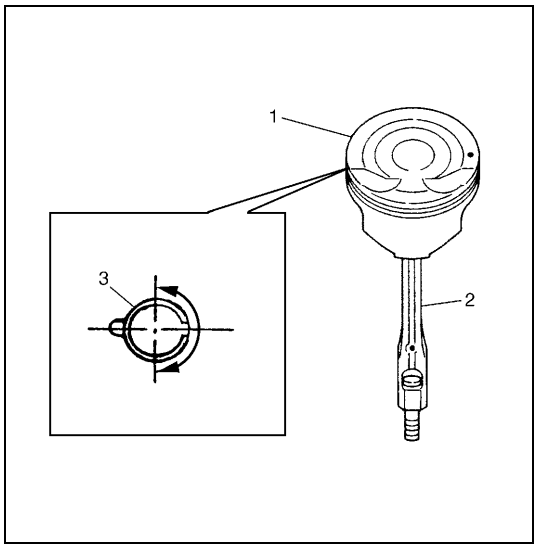
a) Ease out piston pin circlips (1), as shown.



b) Force piston pin out.

Assembly

1) Check connecting rod bolts for deformation referring to "Connecting Rod Bolt Deformation" under "Pistons, Piston Rings, Connecting Rods and Cylinders Inspection" in this section.
   If connecting rod bolt is deformed, use new connecting rod in next step.
2) Decarbonize piston head and ring grooves using a suitable tool.



3) Install piston pin to piston (1) and connecting rod (2) as follows.
   a) Apply engine oil to piston pin and piston pin holes in piston and connecting rod.
   b) Fit connecting rod as shown in figure.
   c) Insert piston pin to piston and connecting rod.
   d) Install piston pin circlips (3).

NOTE:

Circlip should be installed with its cut part facing as shown in figure. Install so that circlip end gap comes within such range as indicated by arrow.

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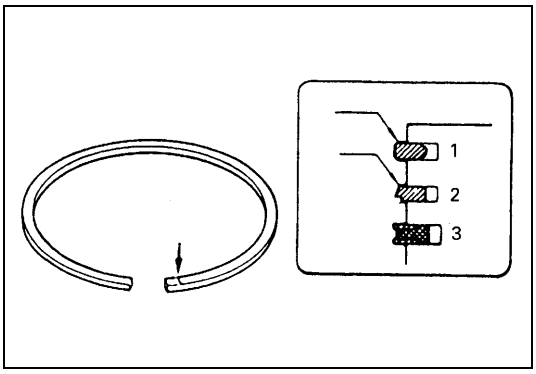
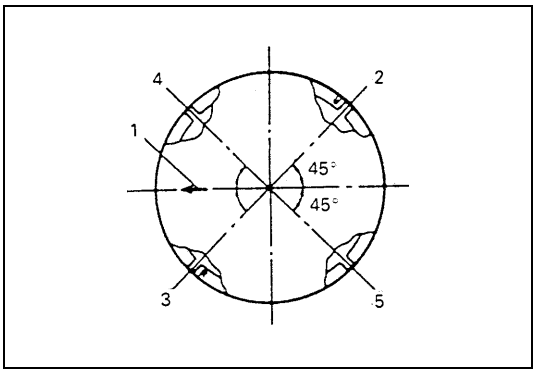


4) Install piston rings to piston:
   a) As indicated in figure, 1st and 2nd rings have "T" mark respectively. When installing these piston rings to piston, direct marked side of each ring toward top of piston.
   b) 1st ring (1) differs from 2nd ring (2) in thickness, shape and color of surface contacting cylinder wall.
      Distinguish 1st ring from 2nd ring by referring to figure.
   c) When installing oil ring (3) install spacer first and then two rails.



5) After installing three rings (1st, 2nd and oil rings), distribute their end gaps as shown in figure.

1.	Arrow mark
2.	1st ring end gap
3.	2nd ring end gap and oil ring spacer gap
4.	Oil ring upper rail gap
5.	Oil ring lower rail gap

Pistons, Piston Rings, Connecting Rods and Cylinders Inspection

Cylinder

Visual inspection

Inspect cylinder walls for scratches, roughness or ridges which indicate excessive wear. If cylinder bore is very rough or deeply scratched or ridged, rebore cylinder and use oversize piston.

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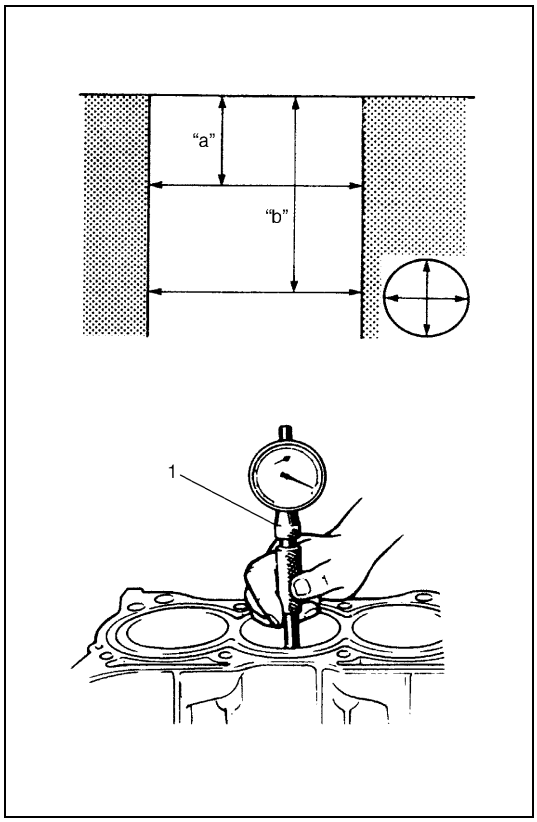
Cylinder bore diameter, taper and out-of-round



Using a cylinder gauge (1), measure cylinder bore in thrust and axial directions at two positions ("a" and "b") as shown in figure.
If any of the following conditions is noted, rebore cylinder.

1) Cylinder bore dia. exceeds limit.
2) Difference of measurements at two positions exceeds taper limit.
3) Difference between thrust and axial measurements exceeds out-of-round limit.

Cylinder bore diameter
Standard: 78.00 – 78.014 mm (3.0709 – 3.0714 in.)
Limit: 78.050 mm (3.073 in.)

Cylinder taper and out-of-round
Limit: 0.10 mm (0.004 in.)

"a": 50 mm (1.96 in.)
"b": 100 mm (3.94 in.)

NOTE:

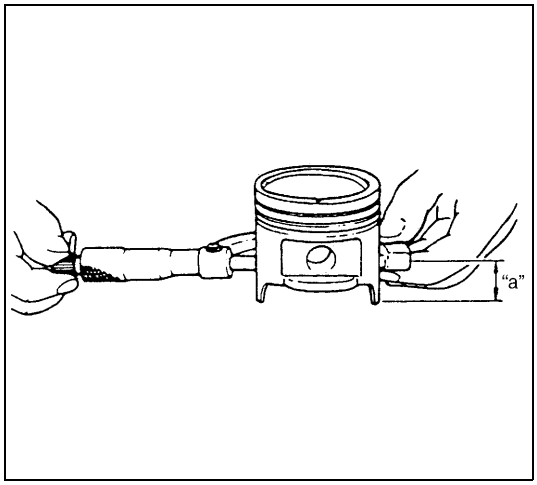
If any one of four cylinders has to be rebored, rebore all four to the same next oversize. This is necessary for the sake of uniformity and balance.

Pistons

Visual inspection

Inspect piston for faults, cracks or other damaged.
Damaged or faulty piston should be replaced.

Piston diameter



As indicated in figure, piston diameter should be measured at a position 5.0 mm (0.20 in.) from piston skirt end in the direction perpendicular to piston pin.

Piston diameter specification

Standard size	**77.953 – 77.968 mm (3.0691 – 3.0696 in.)**
Oversize 0.50 mm (0.0196 in.)	**78.453 – 78.468 mm (3.0888 – 3.0892 in.)**

"a": 5.0 mm (0.20 in.)

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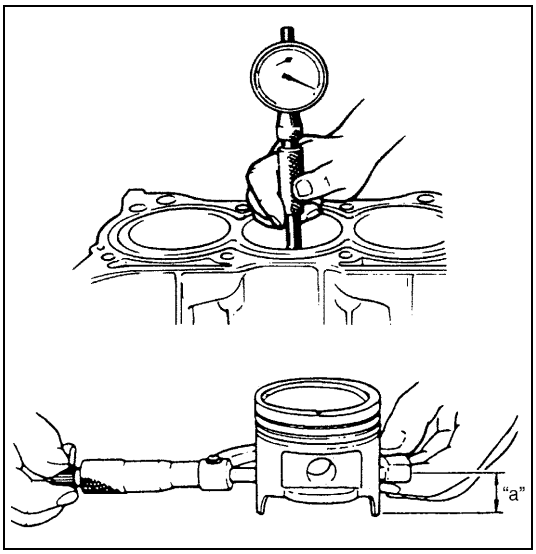


Piston clearance

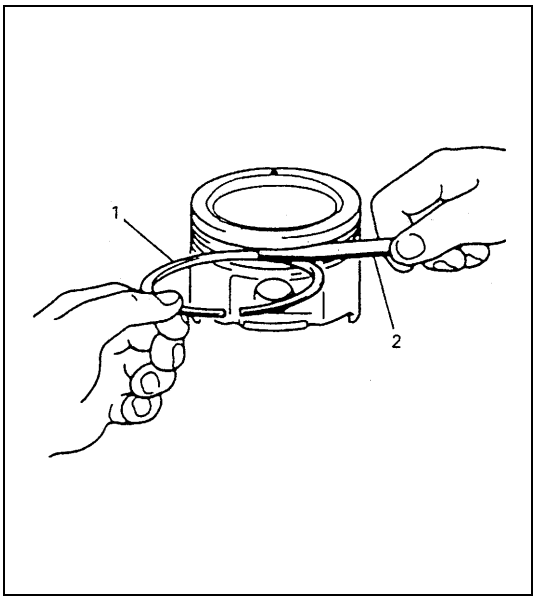
Measure cylinder bore diameter and piston diameter to find their difference which is piston clearance. Piston clearance should be within specification as given below. If it is out of specification, rebore cylinder and use oversize piston.

Piston clearance
Standard: 0.032 – 0.061 mm (0.0013– 0.0024 in.)

NOTE:

Cylinder bore diameters used here are measured in thrust direction at two positions.

"a": 5.0 mm (0.20 in.)



Ring groove clearance

Before checking, piston grooves must be clean, dry and free of carbon deposits.
Fit new piston ring (1) into piston groove, and measure clearance between ring and ring land by using thickness gauge (2). If clearance is out of limit, replace piston.

Ring groove clearance
Top ring
Standard: 0.03 – 0.07 mm (0.0012 – 0.0027 in.)
Limit: 0.12 mm (0.0047 in.)
2nd ring
Standard: 0.02 – 0.06 mm (0.0008 – 0.0023 in.)
Limit: 0.10 mm (0.0039 in.)
Oil ring
Standard: 0.03 – 0.17 mm (0.0012 – 0.0066 in.)

Piston pin

Visual inspection

Check piston pin, connecting rod small end bore and piston bore for wear or damage, paying particular attention to condition of small end bore bush. If pin, connecting rod small end bore or piston bore is badly worn or damaged, replace pin, connecting rod and/or piston.

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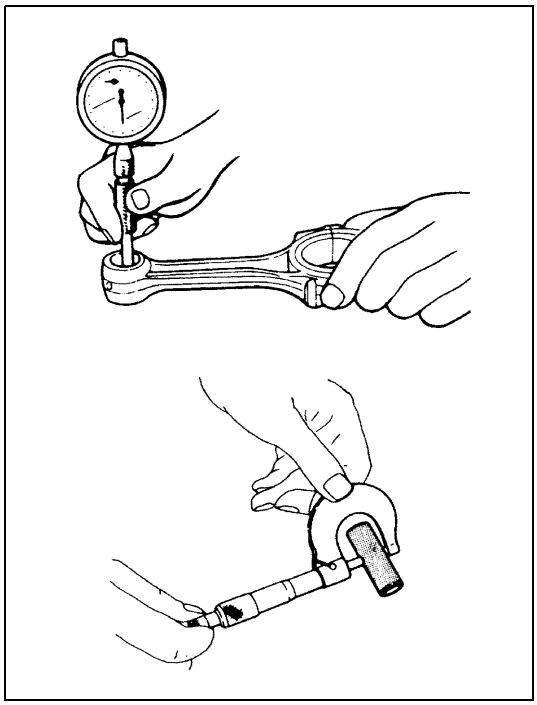


Piston pin clearance

Check piston pin clearance in small end and piston. Replace connecting rod and/or piston if its small end is badly worn or damaged or if measured clearance exceeds limit.

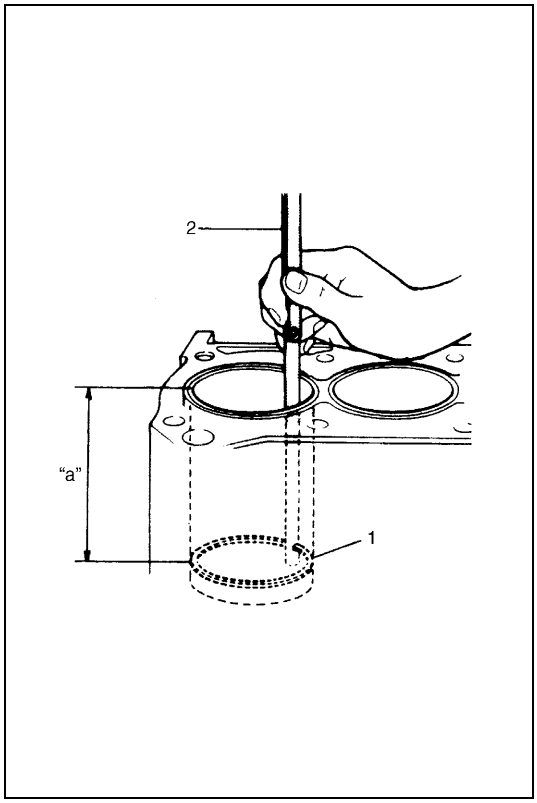
Piston pin clearance in connecting rod small end
Standard: 0.003 – 0.014 mm (0.0002 – 0.0005 in.)
Limit: 0.05 mm (0.0020 in.)

Piston pin clearance in piston
Standard: 0.006 – 0.017 mm (0.00024 – 0.00066 in.)
Limit: 0.05 mm (0.0020 in.)

Small-end bore
20.003 – 20.011 mm (0.7876 – 0.7878 in.)

Piston pin dia.
19.997 – 20.000 mm (0.7873 – 0.7874 in.)

Piston bore
20.006 – 20.014 mm (0.7877 – 0.7879 in.)



Piston rings

Piston ring end gap

To measure end gap, insert piston ring (1) into cylinder bore and then measure the gap by using thickness gauge (2).
If measured gap exceeds limit, replace ring.

NOTE:

Decarbonize and clean top of cylinder bore before inserting piston ring.

Piston ring end gap

Item	Standard	Limit
Top ring	0.20 – 0.35 mm (0.0079 – 0.0137 in.)	0.7 mm (0.0276 in.)
2nd ring	0.30 – 0.45 mm (0.0119 – 0.0177 in.)	1.0 mm (0.0394 in.)
Oil ring	0.20 – 0.70 mm (0.0079 – 0.0275 in.)	1.2 mm (0.0472 in.)

"a": 120 mm (4.72 in.)

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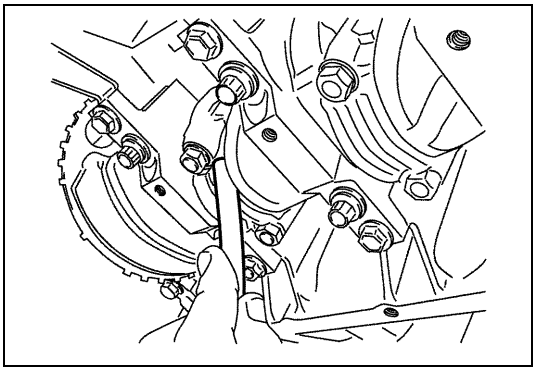
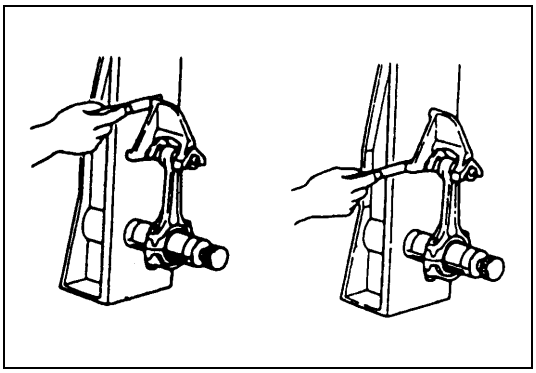
Connecting rod



Big-end side clearance

Check big-end of connecting rod for side clearance, with rod fitted and connected to its crank pin in the normal manner. If measured clearance is found to exceed its limit, replace connecting rod.

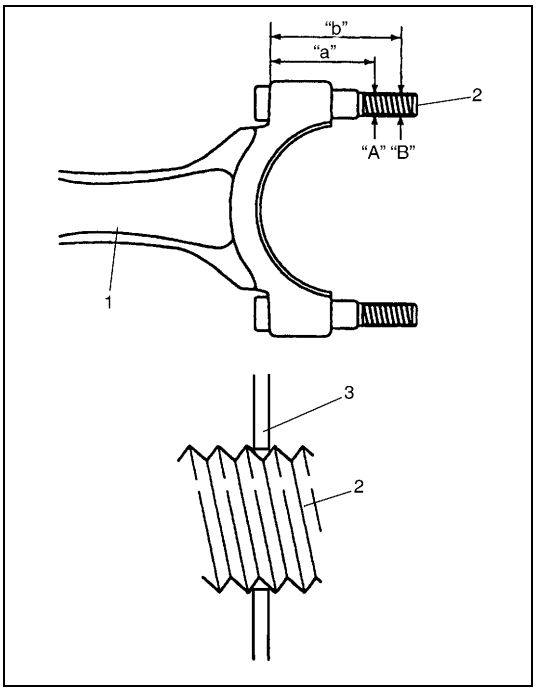
Big-end side clearance
Standard: 0.25 - 0.40 mm (0.0099 - 0.0157 in.)
Limit: 0.55 mm (0.0217 in.)



Connecting rod alignment

Mount connecting rod on aligner to check it for bow and twist. If the measured value exceeds the limit, replace it.

Connecting rod alignment
Limit on bow : 0.05 mm (0.0020 in.)
Limit on twist : 0.10 mm (0.0039 in.)



Connecting rod bolt deformation

Check connecting rod bolt (2) for deformation as follows.
If thread diameter exceeds limit, replace connecting rod with new one.

1) Measure each thread diameter of connecting rod (1) bolt (2) at "A" and "B" by using a micrometer (3).
2) Calculate difference in diameters ("A" – "B").

Connecting rod bolt measurement points
"a": 32 mm (1.25 in.)
"b": 40 mm (1.57 in.)

Connecting rod bolt diameter difference limit ("A" – "B"): 0.1 mm (0.004 in.)

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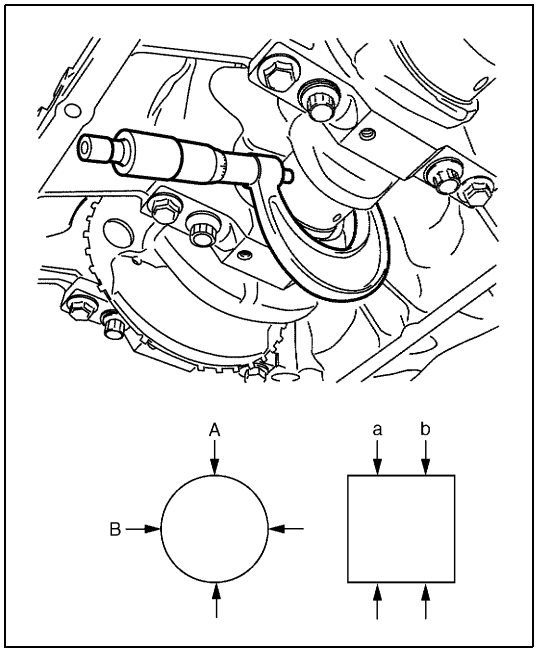
Crank pin and connecting rod bearings

Crank pin diameter



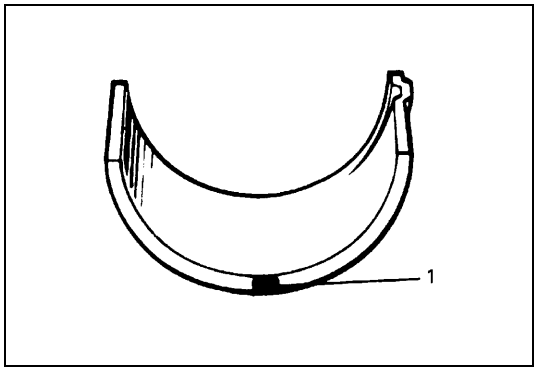
Inspect crank pin for uneven wear or damage. Measure crank pin for out-of-round or taper with a micrometer. If crank pin is damaged or out-of round or taper is out of limit, replace crankshaft or regrind crank pin to undersize and use undersize bearing.

Crank pin diameter

Connecting rod bearing size	Crank pin diameter
Standard	41.982 – 42.000 mm (1.6529 – 1.6535 in.)
Undersize 0.25 mm (0.0098 in.)	41.732 – 41.750 mm (1.6430 – 1.6437 in.)

Crank pin taper and out-of-round
Limit : 0.01 mm (0.0004 in.)
Out-of-round : A – B
Taper : a – b

Connecting rod bearing general information



Service connecting rod bearings are available in standard size and 0.25 mm (0.0098 in.) undersize, and standard size bearing has 5 kinds of bearings differing in tolerance.
For identification of undersize bearing, it is painted red at the position as indicated in figure, undersize bearing thickness is 1.605 – 1.615 mm (0.0632 – 0.0635 in.) at the center of it.

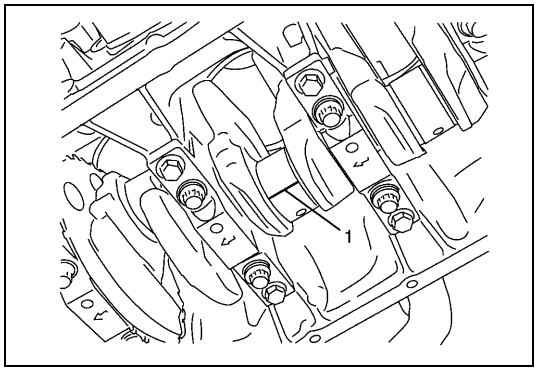
1. Painting

Connecting rod bearing visual inspection

Inspect bearing shells for signs of fusion, pitting, burn or flaking and observe contact pattern. Bearing shells found in defective condition must be replaced.

Connecting rod bearing clearance

1) Before checking bearing clearance, clean bearing and crank pin.
2) Install bearing in connecting rod and bearing cap.
3) Place a piece of gaging plastic (1) to full width of crank pin as contacted by bearing (parallel to crankshaft), avoiding oil hole.



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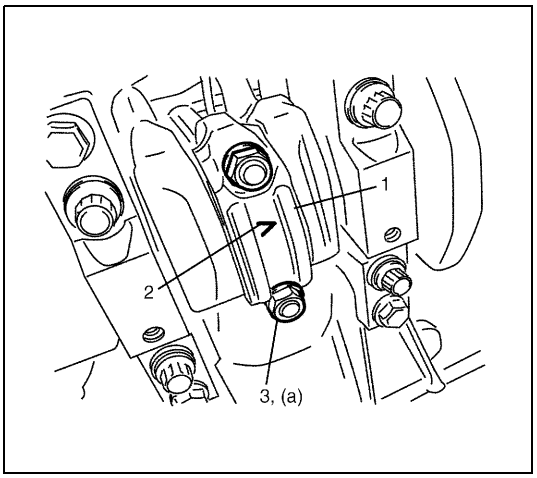
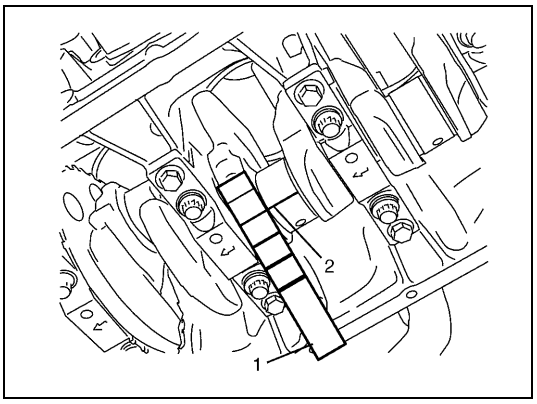


4) Install rod bearing cap (1) to connecting rod.
When installing cap, be sure to point arrow mark (2) on cap to crankshaft pulley side, as shown in figure. After applying engine oil to rod bolts and tighten cap nuts (3) gradually as follows.
a) Tighten all cap nuts to 15 N·m (1.5 kg-m, 11.0 lb-ft).
b) Retighten them to 45 °.
c) Repeat step b) once again.

Tightening torque
Connecting rod bearing cap nut
(a): Tighten 15 N·m (1.5 kg-m, 11.0 lb-ft), 45 ° and 45 °
by the specified procedure



5) Remove cap and using a scale (1) on gaging plastic (2) envelope, measure gaging plastic width at the widest point (clearance).
If clearance exceed its limit, use a new standard size bearing referring to “Selection of Connecting Rod Bearings” in this section.
After selecting new bearing, recheck clearance.

Connecting rod bearing clearance
Standard: 0.029 – 0.047 mm (0.0012 – 0.0018 in.)
Limit: 0.065 mm (0.0026 in.)

6) If clearance can not be brought to its limit even by using a new standard size bearing, regrind crank pin to undersize and use 0.25 mm undersize bearing.

NOTE:

After checking the rod bearing clearance, make sure that checking for Connecting rod bolt deformation.
Refer to “Connecting Rod” under “Pistons, Piston Rings, Connecting Rods and Cylinders Inspection”.

Selection of connecting rod bearings

NOTE:

- **If bearing is in malcondition, or bearing clearance is out of specification, select a new standard bearing according to the following procedure and install it.**
- **When replacing crankshaft or connecting rod and its bearing due to any reason, select new standard bearings to be installed by referring to numbers stamped on connecting rod and its cap and/or alphabets stamped on crank web of No.3 cylinder.**

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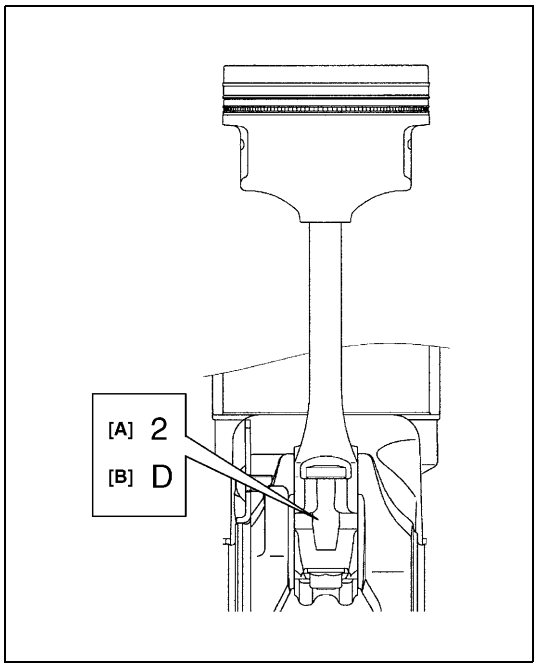
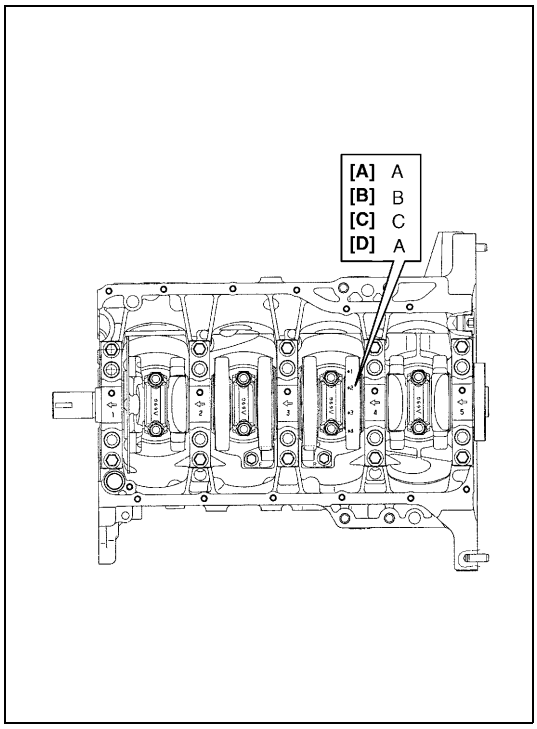


1) Check stamped numbers on connecting rod and its cap as shown.
   Three kinds of numbers ("1", "2" and "3") represent the following connecting rod big end inside diameters.
   For example, stamped number "1" indicates that corresponding connecting rod big end inside diameter is 45.000 – 45.006 mm (1.7717 – 1.7718 in.).

Connecting rod big end inside diameter

Stamped numbers	connecting rod big end inside diameter
1	45.0000 – 45.0060 mm (1.7717 – 1.7718 in.)
2	45.0061 – 45.0120 mm (1.7719 – 1.7721 in.)
3	45.0121 – 45.0180 mm (1.7722 – 1.7723 in.)

[A]: Connecting rod big end inside diameter number
[B]: Weight indication mark



2) Next, check crankshaft pin diameter. On crank web No.3, four alphabets are stamped as shown in figure.
   Three kinds of alphabet ("A", "B" and "C") represent the following crankshaft pin diameter respectively.
   For example, stamped "A" indicates that corresponding crankshaft pin diameter is 41.994 – 42.000 mm (1.6533 – 1.6535 in.).

Crankshaft pin outer diameter

Stamped alphabet	Crankshaft pin diameter
A	41.9940 – 42.0000 mm (1.6533 – 1.6535 in.)
B	41.9880 – 41.9939 mm (1.6531 – 1.6533 in.)
C	41.9820 – 41.9879 mm (1.6529 – 1.6530 in.)

[A]: Crankshaft pin diameter for No.1 cylinder
[B]: Crankshaft pin diameter for No.2 cylinder
[C]: Crankshaft pin diameter for No.3 cylinder
[D]: Crankshaft pin diameter for No.4 cylinder

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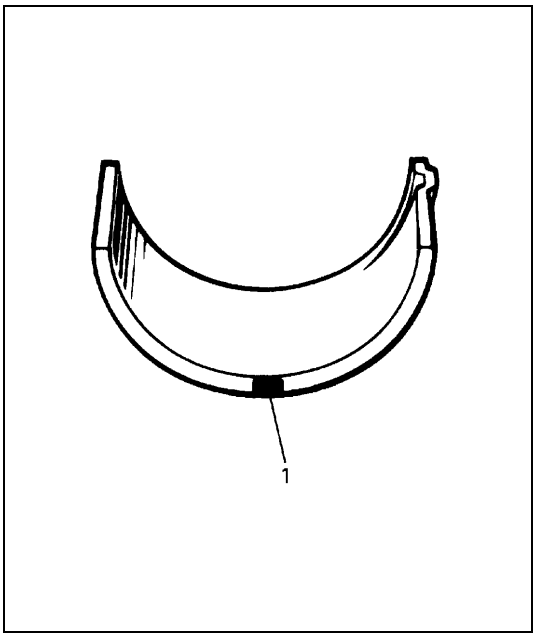


3) There are five kinds of standard bearings differing in thickness. To distinguish them, they are painted in the following colors at the position as indicated in figure.
Each color indicated the following thickness at the center of bearing.

Standard size of connecting rod bearing thickness

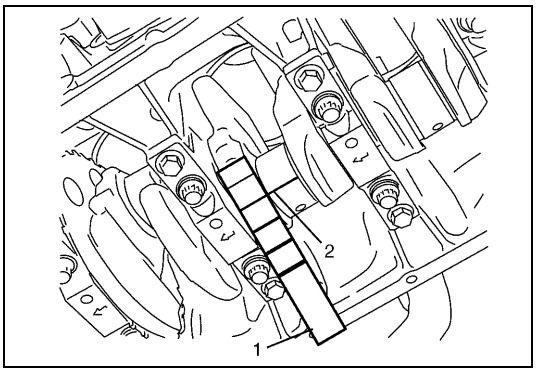
Color painted	Bearing thickness
Blue	1.4991 – 1.5020 mm (0.05902 – 0.05913 in.)
Yellow	1.4961 – 1.4990 mm (0.05890 – 0.05901 in.)
Nothing	1.4931 – 1.4960 mm (0.05878 – 0.05889 in.)
Black	1.4901 – 1.4930 mm (0.05867 – 0.05877 in.)
Green	1.4870 – 1.4900 mm (0.05855 – 0.05866 in.)

1. Paint

4) From number stamped on connecting rod and its cap and alphabets stamped on crank web No.3, determine new standard bearing to be installed to connecting rod big end inside, by referring to table.
For example, if number stamped on connecting rod and its cap is “1” and alphabet stamped on crank web No.3 is “B”, install a new standard bearing painted in “Black” to its connecting rod big end inside.

Specification of new standard connecting rod bearing size

		Number stamped on connecting rod and its cap (connecting rod big end inside diameter)		
		1	2	3
Alphabet stamped on crank web No.3 (Crankshaft pin diameter)	A	Green	Black	Nothing
	B	Black	Nothing	Yellow
	C	Nothing	Yellow	Blue
		New standard bearing to be installed.		



5) Using scale (1) on gaging plastic (2), check bearing clearance with newly selected standard bearing.
If clearance still exceeds its limit, use next thicker bearing and recheck clearance.

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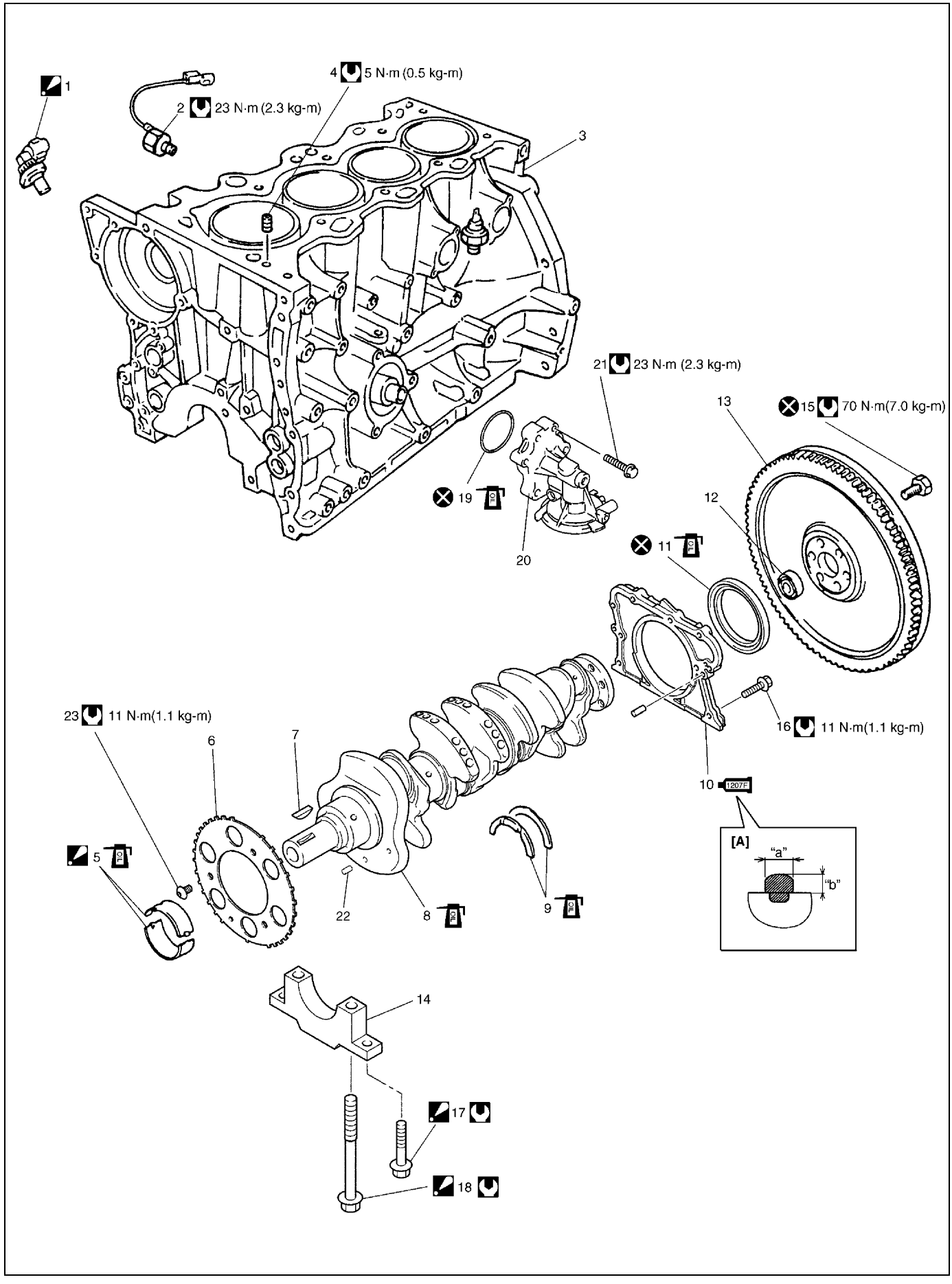
Main Bearings, Crankshaft and Cylinder Block Components



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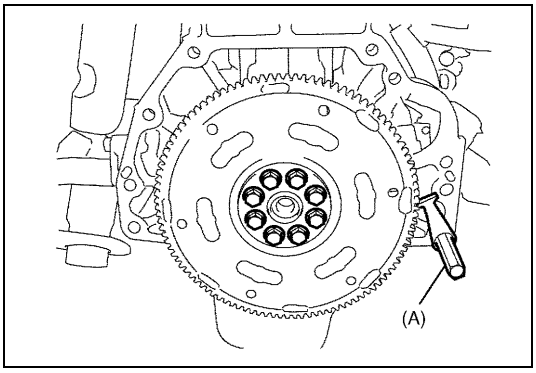
[A] : Sealant application amount	5. Main bearing : Upper half of bearing has an oil groove	15. Flywheel mounting bolt
Tightening torque	6. Sensor plate	16. Rear oil seal housing mounting bolt
Do not reuse.	7. Crankshaft timing sprocket key	17. Main bearing cap No.2 bolt : Tighten 25 N·m (2.5 kg-m, 18.0 lb-ft) by the specified procedure.
Apply engine oil to inside / sliding surface.	8. Crankshaft	18. Main bearing cap No.1 bolt : Make sure main bearing cap No.1 bolt diameter when reuse it due to plastic deformation tightening. Refer to “Main Bearings, Crankshaft and Cylinder Block Inspection” in this section. : Tighten 30 N·m (3.0 kg-m, 22.0 lb-ft), 50 N·m (5.0 kg-m, 36.5 lb-ft) and 60 ° by the specified procedure.
“a” : 3 mm (0.12 in.)	9. Thrust bearing	19. O-ring
“b” : 2 mm (0.08 in.)	10. Rear oil seal housing : Apply sealant 99000-31250 to mating surface.	20. Oil filter adapter case
1. CKP sensor (if equipped) : When installing CKP sensor, use new sensor mounting bolt.	11. Rear oil seal	21. Oil filter adapter bolt
2. Knock sensor	12. Input shaft bearing	22. Spring pin
3. Cylinder block	13. Flywheel	23. Sensor plate bolt
4. Venturi plug	14. Main bearing cap	

Main Bearings, Crankshaft and Cylinder Block Removal and Installation

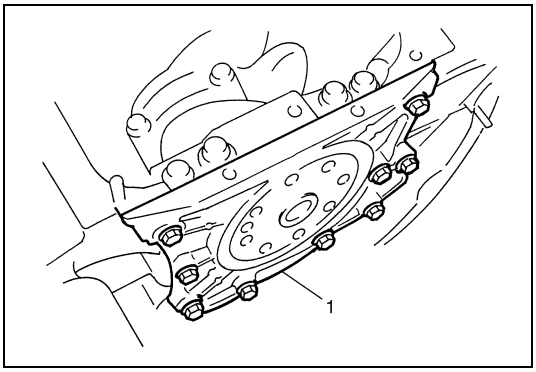
Removal

1) Remove engine assembly from vehicle referring to “Engine Assembly Removal and Installation” in this section.
2) Remove clutch cover, clutch disc and flywheel by using special tool.



Special tool
(A): 09924-17811

3) Remove piston and connecting rod referring to “Pistons, Piston Rings, Connecting Rods and Cylinders Removal and Installation” in this section.
4) Remove rear oil seal housing (1).



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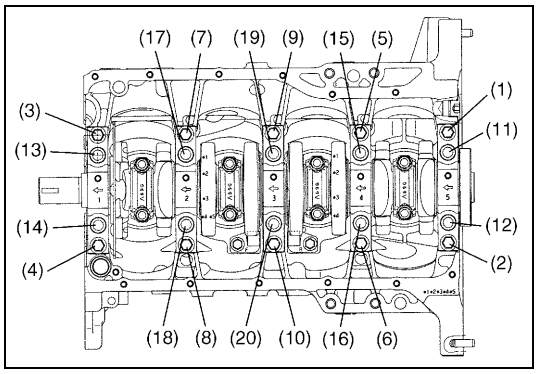
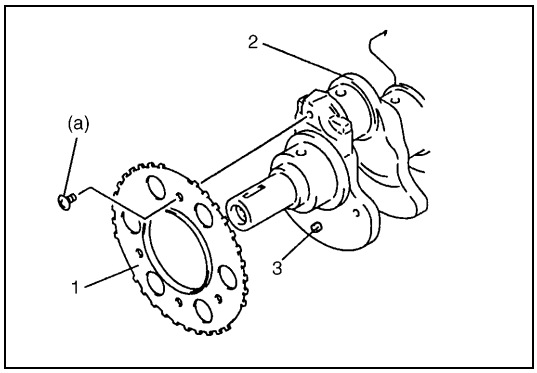


5) Loosen main bearing cap No.1 and No.2 bolts in such order as indicated in figure and remove them.
6) Remove crankshaft from cylinder block.

Installation

CAUTION:
- **All parts to be installed must be perfectly clean.**
- **Be sure to oil crankshaft journals, journal bearings, thrust bearings, crankpins, connecting rod bearings, pistons, piston rings and cylinder bores.**
- **Journal bearings, bearings caps, connecting rods, rod bearings, rod bearing caps, pistons and piston rings are in combination sets. Do not disturb such combination and make sure that each part goes back to where it came from, when installing.**

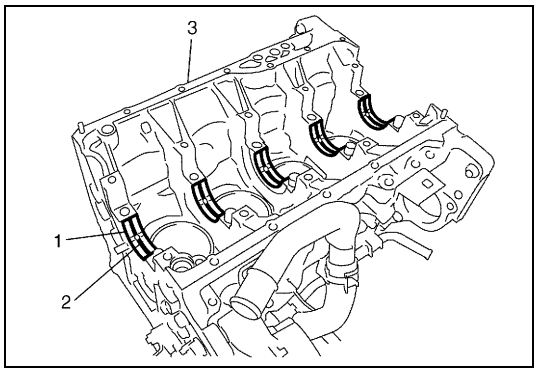


1) Install sensor plate (1) to crankshaft (2) and tighten bolts to specified torque.

NOTE:

When installing sensor plate, align spring pin (3) on crankshaft and hole of sensor plate.

Tightening torque
Sensor plate bolt (a): 11 N·m (1.1 kg-m, 8.0 lb-ft)



2) Install main bearings to cylinder block.
Upper half of bearing (1) has an oil groove (2).
Install it to cylinder block (3), and the other half without oil groove to bearing cap.
Make sure that two halves are painted in the same color.

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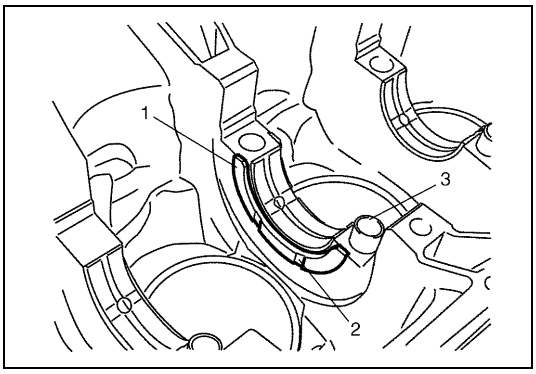
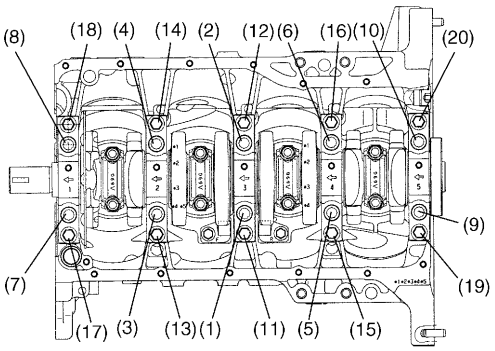


3) Install thrust bearings (1) to cylinder block between No.2 and No.3 cylinders. Face oil groove (2) sides to crank webs.
4) Confirm that dowel pins (3) are installed to intake side of each journal.
5) Install crankshaft to cylinder block.



6) Check main bearing No.1 bolts for deformation referring to "Main Bearings, Crankshaft and Cylinder Block Inspection" in this section.
   If main bearing No.1 bolt is deformed, use new one in next step.
7) Install bearing cap to cylinder block, making sure to point arrow mark (on each cap) to crankshaft pulley side. Fit them sequentially in ascending order, 1, 2, 3, 4 and 5, starting from pulley side.
   After applying engine oil to main bearing cap No.1 bolts ((1) – (10)) and main bearing cap No.2 bolts ((11) – (20)), tighten them gradually as follows.
   a) Tighten bolts (1) – (10) to 30 N·m (3.0 kg-m, 22.0 lb-ft) according to numerical order as shown by using a 12 corner socket wrenches.
   b) In the same manner as in Step a), tighten them to 50 N·m (5.0 kg-m, 36.5 lb-ft).
   c) In the same manner as in Step a), retighten them to 60°.
   d) Tighten bolts (11) – (20) to 25 N·m (2.5 kg-m, 18.0 lb-ft) according to numerical order as shown.

Tightening torque
Main bearing No.1 bolt (1) – (10)
: Tighten 30 N·m (3.0 kg-m, 22.0 lb-ft),
50 N·m (5.0 kg-m, 36.5 lb-ft) and 60 °
by the specified procedure
Main bearing No.2 bolt (11) – (20)
: Tighten 25 N·m (2.5 kg-m, 18.0 lb-ft)
by the specified procedure

CAUTION:
After tightening cap bolts, check to be sure that crankshaft rotates smoothly when turning it by 12 N·m (1.2 kg-m, 9.0 lb-ft) torque or below.

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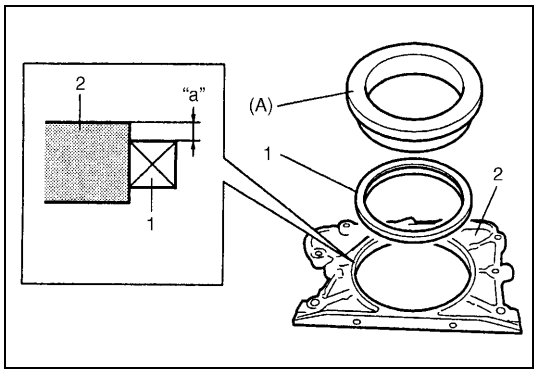
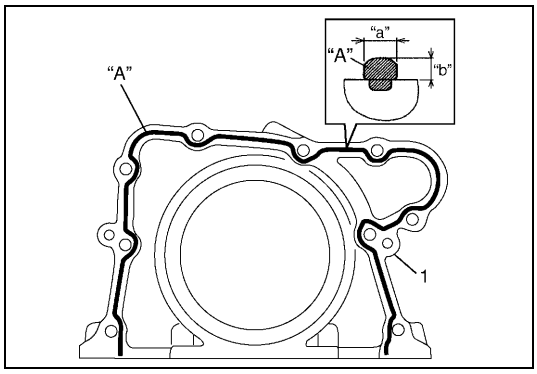


8) If necessary, press-fit rear oil seal (1) to oil seal housing (2) by using special tool as shown in the figure.

Special tool
(A): 09911-97820

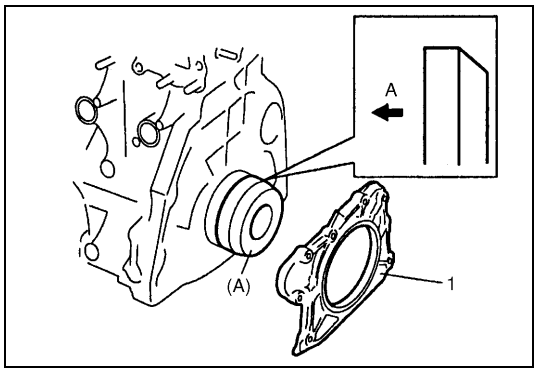
Crank rear oil seal installing position (dimension)
"a": 3 mm (0.12 in.)



9) Apply sealant to mating surface of rear oil seal housing (1).

"A": Sealant 99000-31250

Sealant amount for rear oil seal housing
Width "a": 3 mm, 0.12 in.
Height "b": 2 mm, 0.08 in.

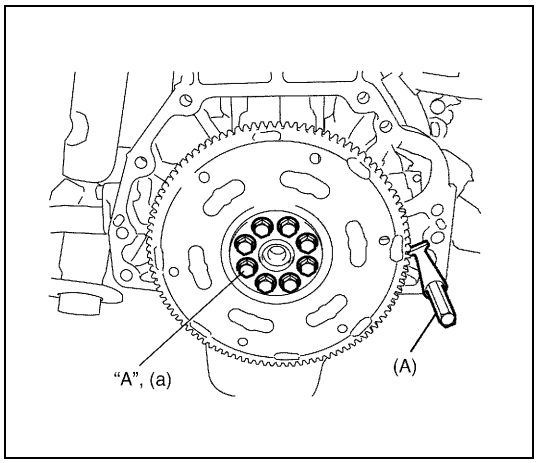


10) Install rear oil seal housing (1) and tighten bolts to specified torque by using special tool.

Special tool
(A): 09911-97720

Tightening torque
Rear oil seal housing bolt: 11 N·m (1.1 kg-m, 8.0 lb-ft)

A : Crankshaft side



11) Install flywheel.
Using special tool, lock flywheel or drive plate, and tighten flywheel or drive plate bolts to specified torque.

NOTE:
Use new flywheel or drive plate bolts.

Special tool
(A): 09924-17810

Tightening torque
Flywheel or drive plate bolt
(a): 70 N·m (7.0 kg-m, 51.0 lb-ft)

12) Install piston and connecting rod referring to "Pistons, Piston Rings, Connecting Rods and Cylinders Removal and Installation" in this section.
13) Install engine assembly to vehicle referring to "Engine Assembly Removal and Installation" in this section.

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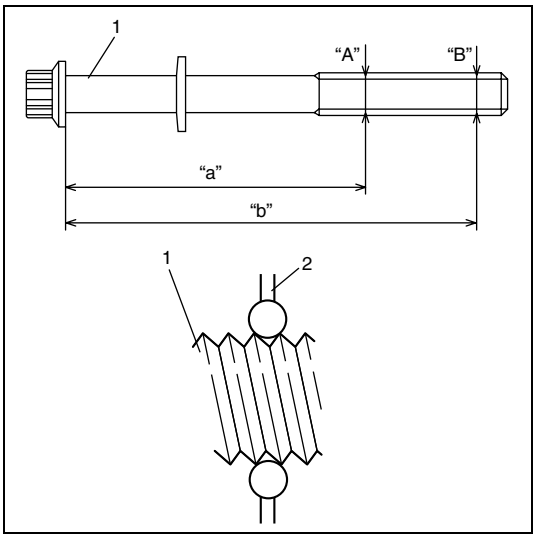
Main Bearings, Crankshaft and Cylinder Block Inspection

Main bearing cap No.1 bolt



Check main bearing cap No.1 bolt (1) for deformation as follows. If thread diameter exceeds limit, replace connecting rod with new one.

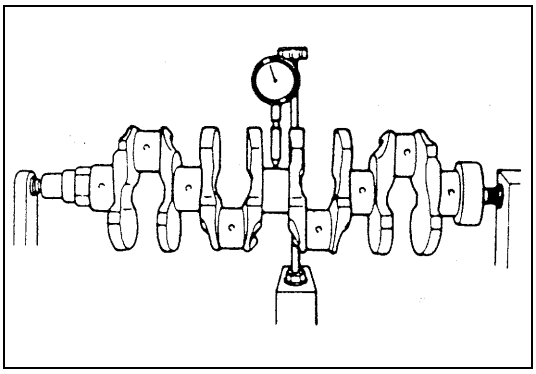
1) Measure each thread diameter main bearing cap No.1 bolts (1) at "A" and "B" by using a micrometer (2).
2) Calculate difference in diameters ("A" – "B").

Main bearing cap No.1 bolt diameter measurement points
"a": 60mm (2.36in.)
"b": 90mm (3.54in.)

Main bearing cap No.1 bolt diameter difference
Limit ("A" – "B"): 0.2mm (0.008in.)

Crankshaft

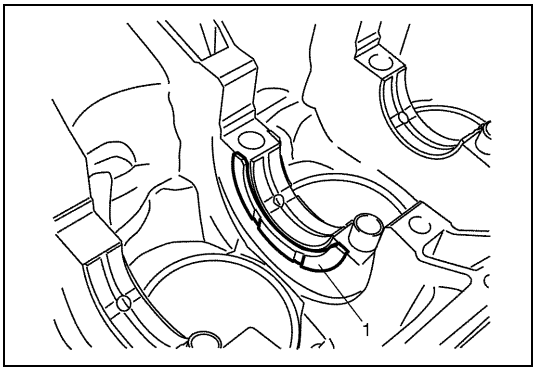
Crankshaft runout



Using a dial gauge, measure runout at center journal. Rotate crankshaft slowly. If runout exceeds its limit, replace crankshaft.

Crankshaft runout
Limit: 0.02 mm (0.0008 in.)

Crankshaft Thrust Play



1) Measure this play with crankshaft set in cylinder block in the normal manner, that is with thrust bearing (1) and journal bearing caps installed.

Thickness of crankshaft thrust bearing
Standard: 2.470 – 2.520 mm (0.0973 – 0.0992 in.)
Oversize (0.125 mm (0.0049 in.)): 2.533 – 2.583 mm (0.0998 – 0.1016 in.)

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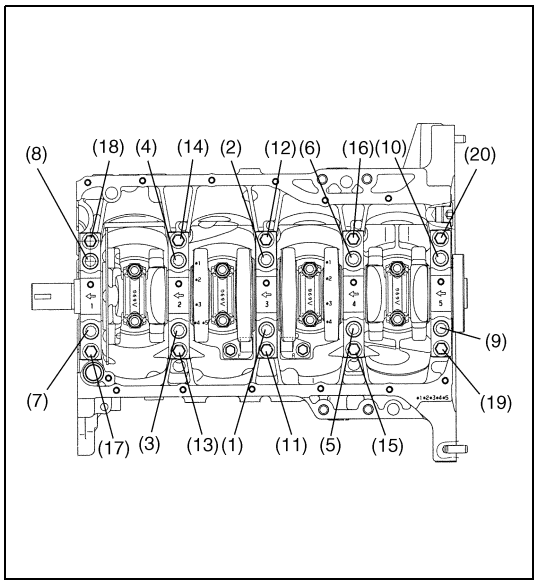
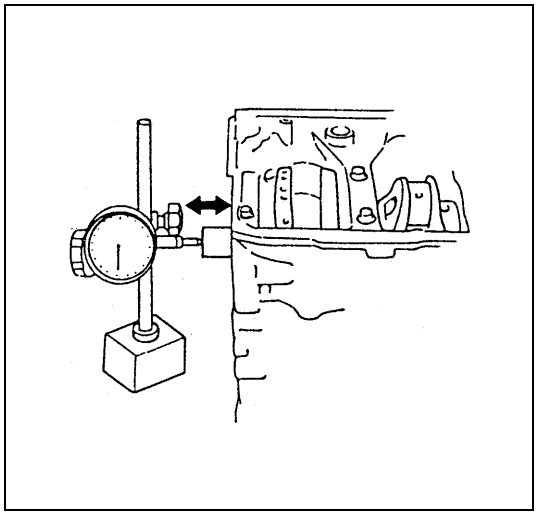


2) Tighten main bearing cap No.1 bolts (1) – (10) and main bearing cap No.2 bolts (11) – (20) gradually as follows.
   a) Tighten bolts (1) – (10) to 30 N·m (3.0 kg-m, 22.0 lb-ft) according to numerical order in figure.
   b) In the same manner as in Step 1), tighten them to 50 N·m (5.0 kg-m, 36.5 lb-ft).
   c) In the same manner as in step 1), retighten them to 60°.
   d) Tighten bolts (11) – (20) to 25 N·m (2.5 kg-m, 18.0 lb-ft) according to numerical order in figure.

Tightening torque
Main bearing cap No.1 bolt (1) – (10):
Tighten 30 N·m (3.0 kg-m, 22.0 lb-ft),
50 N·m (5.0 kg-m, 36.5 lb-ft) and 60 °
by the specified procedure
Main bearing cap No.2 bolt (11) – (20):
Tighten 25 N·m (2.5 kg-m, 18.0 lb-ft)
by the specified procedure



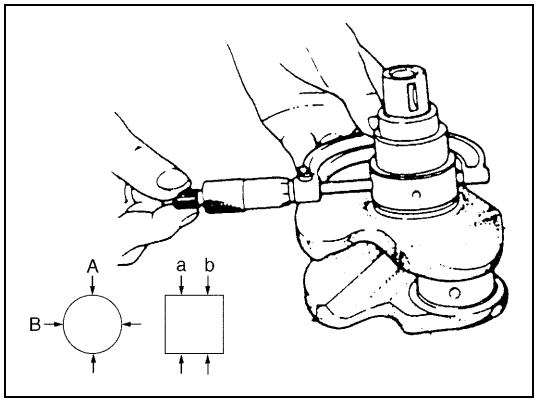
3) Use a dial gauge to read displacement in axial (thrust) direction of crankshaft.
   If its limit is exceeded, replace thrust bearing with new standard one or oversize one to obtain standard thrust play.

Crankshaft thrust play
Standard : 0.11 – 0.31 mm (0.0043 – 0.0122 in.)
Limit: 0.35 mm (0.0138 in.)

NOTE:

After checking the thrust play, make sure that thread deformation of each main bearing cap No.1 bolt referring to "Main Bearing Cap No.1 Bolt" in this section.

Out-of-round and Taper (Uneven Wear) of Journals



An unevenly worn crankshaft journal shows up as a difference in diameter at a cross section or along its length (or both). This difference, if any, is determined by taking micrometer readings. If any one of journals is badly damaged or if amount of uneven wear in the sense explained below exceeds its limit, regrind or replace crankshaft.

Crankshaft out-of-round and taper
Limit : 0.01 mm (0.0004 in.)
Out-of-round : A – B
Taper : a – b

Main bearings

General Information

- Service main bearings are available in standard size and 0.25 mm (0.0098 in.) undersize, and each of them has 5 kinds of bearings differing in tolerance.

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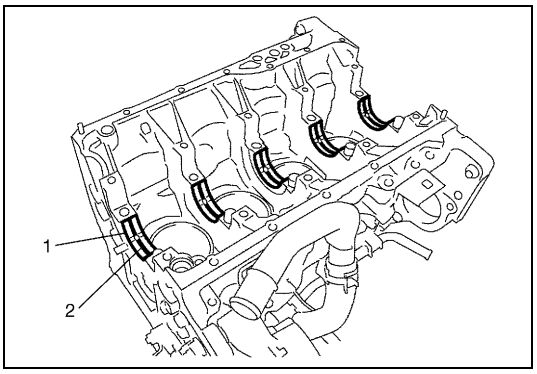


- Upper half of bearing (1) has an oil groove (2) as shown in figure.
  Install this half with oil groove to cylinder block.
- Lower half of bearing does not have an oil groove.

Visual Inspection

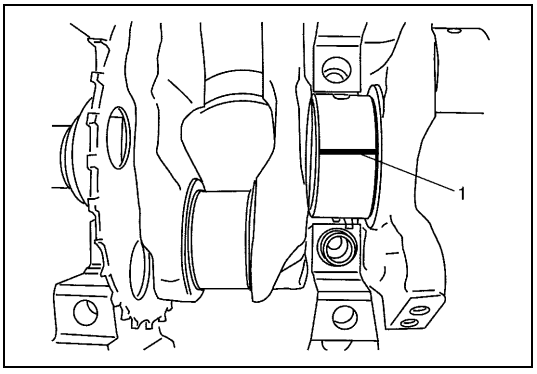
Check bearings for pitting, scratches, wear or damage.
If any malcondition is found, replace both upper and lower halves.
Never replace either half without replacing the other half.

Main Bearing Clearance

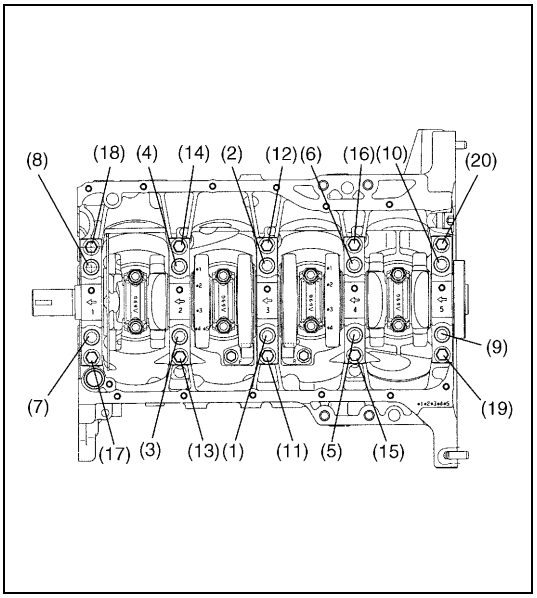
CAUTION:
Do not rotate crankshaft while gaging plastic is installed.

Check clearance by using gaging plastic according to the following procedure.

1) Remove bearing caps.
2) Clean bearings and main journals.



3) Place a piece of gaging plastic (1) the full width of bearing (parallel to crankshaft) on journal, avoiding oil hole.



4) Tighten main bearing cap No.1 bolts (1) – (10) and main bearing No.2 cap bolts (11) – (20) gradually as follows.
   a) Tighten bolts (1) – (10) to 30 N·m (3.0 kg-m, 22.0 lb-ft) according to numerical order in figure.
   b) In the same manner as in Step a), tighten them to 50 N·m (5.0 kg-m, 36.5 lb-ft).
   c) In the same manner as in step a), retighten them to 60°.
   d) Tighten bolts (11) – (20) to 25 N·m (2.5 kg-m, 18.0 lb-ft) according to numerical order in figure.

Tightening torque
Main bearing cap No.1 bolt (1) – (10):
Tighten 30 N·m (3.0 kg-m, 22.0 lb-ft),
50 N·m (5.0 kg-m, 36.5 lb-ft) and 60 °
by the specified procedure

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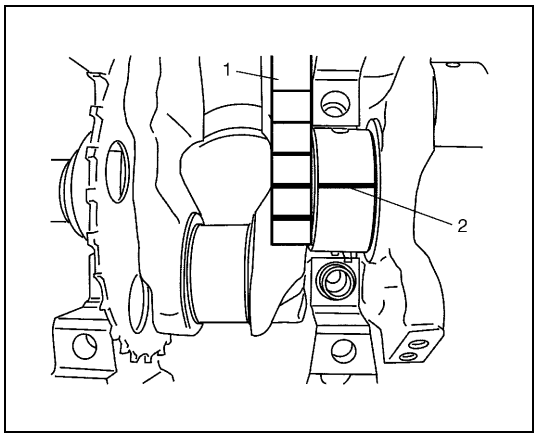
Main bearing cap No.2 bolt (11) – (20):
Tighten 25 N·m (2.5 kg-m, 18.0 lb-ft)
by the specified procedure



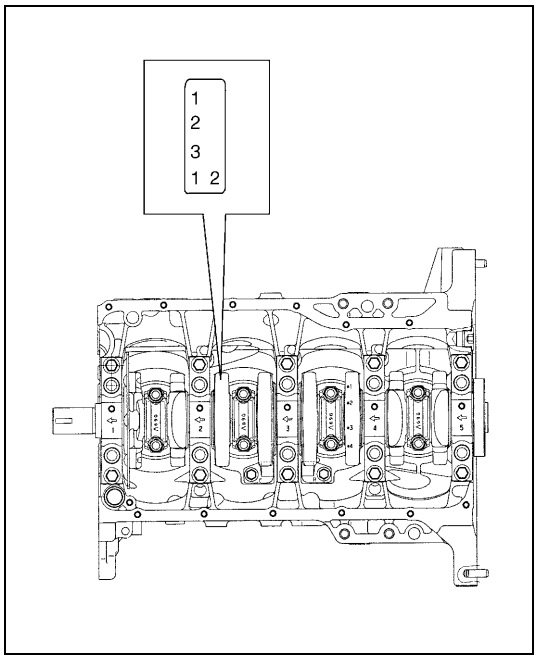
5) Remove bearing caps and using scale (1) on gaging plastic (2) envelop, measure gaging plastic width at its widest point.
If clearance exceeds its limit, replace bearing. Always replace both upper and lower inserts as a unit.
A new standard bearing may produce proper clearance. If not, it will be necessary to regrind crankshaft journal for use of 0.25 mm (0.0098 in.) undersize bearing.
After selecting new bearing, recheck clearance.

Main bearing clearance
Standard: 0.021 – 0.041 mm (0.0008 – 0.0016 in.)
Limit: 0.054 mm (0.0021 in.)

Selection of Main Bearings

Standard Bearing

If bearing is in malcondition, or bearing clearance is out of specification, select a new standard bearing according to the following procedure and install it.



1) First check journal diameter. As shown in figure, crank web No.2 has stamped numbers.
Three kinds of numbers (“1”, “2” and “3”) represent the following journal diameters.
Stamped numbers on crank web No.2 represent journal diameters marked with an arrow in figure respectively.
For example, stamped number “1” indicates that corresponding journal diameter is 51.9940 – 52.0000 mm (2.0471 – 2.0472 in.).

Crankshaft journal diameter

Stamped numbers	Journal diameter
1	51.9940 – 52.0000 mm (2.0471 – 2.0472 in.)
2	51.9880 – 51.9939 mm (2.0468 – 2.0470 in.)
3	51.9820 – 51.9879 mm (2.0466 – 2.0467 in.)

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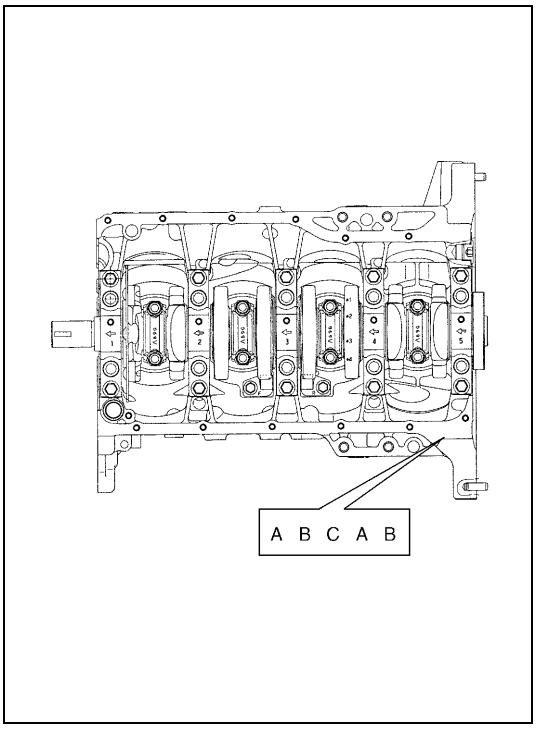
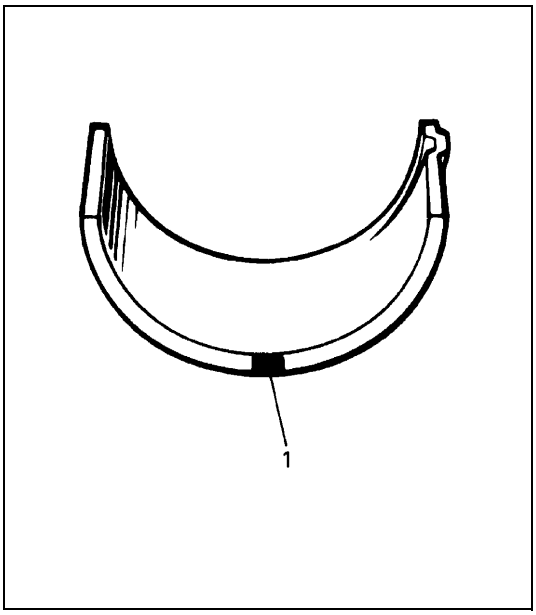


2) Next, check bearing cap bore diameter without bearing. On mating surface of cylinder block, five alphabets are stamped as shown in figure.
Three kinds of alphabets (“A”, “B” and “C”) or numbers (“1”, “2” and “3”) represent the following cap bore diameters.
Stamped alphabets or numbers on cylinder block represent bearing cap bore diameter marked with an arrow in figure respectively. For example, stamped “A” or “1” indicates that corresponding bearing cap bore diameter is 56.0000 – 56.0060 mm (2.2048 – 2.2049 in.).

Crankshaft bearing cap bore

Stamped alphabet (number)	Bearing cap bore diameter (without bearing)
A (1)	56.0000 – 56.0060 mm (2.2048 – 2.2049 in.)
B (2)	56.0061 – 56.0120 mm (2.2050 – 2.2051 in.)
C (3)	56.0121 – 56.0180 mm (2.2052 – 2.2054 in.)



3) There are five kinds of standard bearings differing in thickness. To distinguish them, they are painted in the following colors at the position as indicated in figure.
Each color indicated the following thickness at the center of bearing.

Standard size of crankshaft main bearing thickness

Color painted	Bearing thickness
Purple	1.992 – 1.996 mm (0.07843 – 0.07858 in.)
Brown	1.995 – 1.999 mm (0.07855 – 0.07870 in.)
Green	1.998 – 2.002 mm (0.07867 – 0.07881 in.)
Black	2.001 – 2.005 mm (0.07878 – 0.07893 in.)
Colorless (no paint)	2.004 – 2.008 mm (0.07890 – 0.07905 in.)

1. Paint

4) From number stamped on crank web No.2 and alphabets stamped on cylinder block, determine new standard bearing to be installed to journal, by referring to table shown below.
For example, if number stamped on crank web No.2 is “1” and alphabet stamped on cylinder block is “B”, install a new standard bearing painted in “Brown” to its journal.

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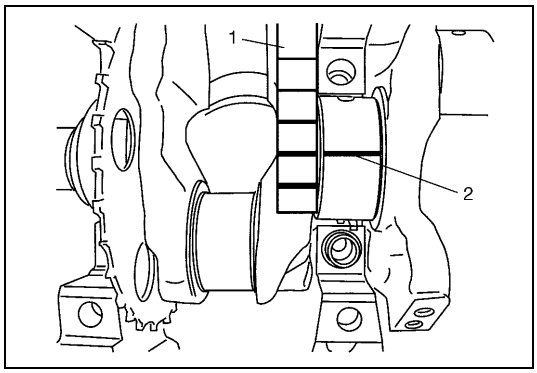
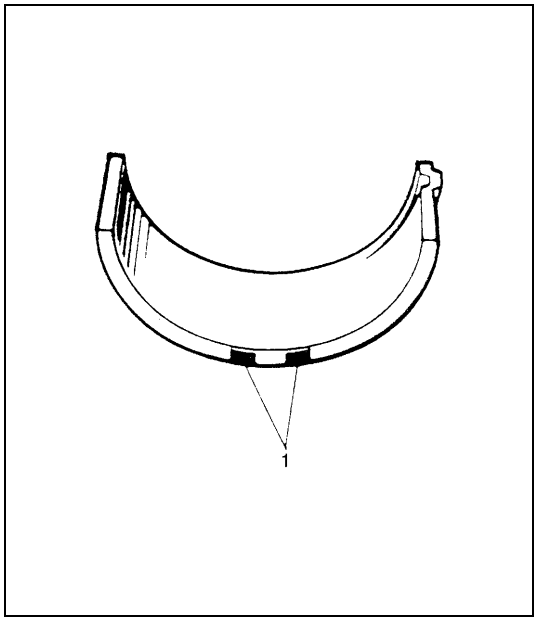
Specification of new standard crankshaft main bearing size

		Number stamped on crank web No.2 (Journal diameter)		
		1	2	3
Alphabet stamped on cylinder block (Cap bore dia.)	A (1)	Purple	Brown	Green
	B (2)	Brown	Green	Black
	C (3)	Green	Black	Colorless
		New standard bearing to be installed.		



5) Using scale (1) on gaging plastic (2), check bearing clearance with newly selected standard bearing.
   If clearance still exceeds its limit, use next thicker bearing and recheck clearance.
6) When replacing crankshaft or cylinder block due to any reason, select new standard bearings to be installed by referring to number stamped on new crankshaft or alphabets stamped on new cylinder block.

Undersize bearing (0.25 mm (0.0098 in.))



- 0.25 mm (0.0098 in.) undersize bearing is available, in five kinds varying in thickness.
  To distinguish them, each bearing is painted in the following colors at such position as indicated in figure.
  Each color represents the following thickness at the center of bearing.

Undersize of crankshaft main bearing thickness

Color painted	Bearing thickness
Red and Purple	2.117 – 2.121 mm (0.08335 – 0.08350 in.)
Red and Brown	2.120 – 2.124 mm (0.08347 – 0.08362 in.)
Red and Green	2.123 – 2.127 mm (0.08359 – 0.08374 in.)
Red and Black	2.126 – 2.130 mm (0.08371 – 0.08385 in.)
Red only	2.129 – 2.133 mm (0.08382 – 0.08397 in.)

1. Paint

- If necessary, regrind crankshaft journal and select undersize bearing to use with it as follows.

1) Regrind journal to the following finished diameter.

Finished diameter
51.732 – 51.750 mm (2.0367 – 2.0374 in.)

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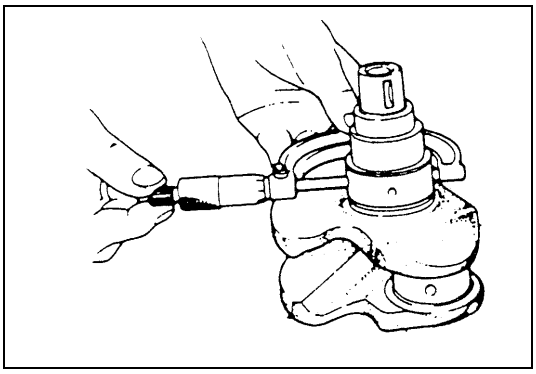
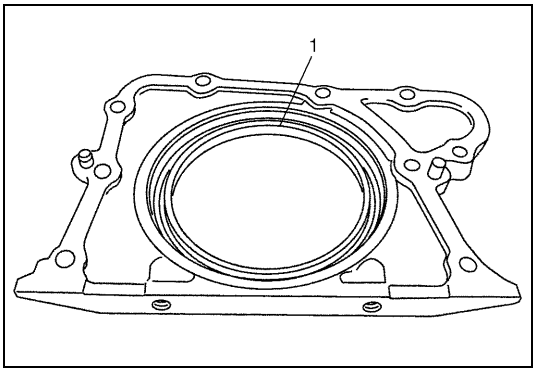


2) Using micrometer, measure reground journal diameter.
   Measurement should be taken in two directions perpendicular to each other in order to check for out-of-round.
3) Using journal diameter measured above and alphabets stamped on cylinder block, select an undersize bearing by referring to table given below.
   Check bearing clearance with newly selected undersize bearing.

Specification of new standard undersize crankshaft main bearing

		Measured journal diameter		
		51.7320 – 51.7379 mm (2.0367 – 2.0369 in.)	51.7380 – 51.7439 mm (2.0370 – 2.0371 in.)	51.7440 – 51.7500 mm (2.0372 – 2.0374 in.)
Alphabets stamped on cylinder block	A (1)	Red and Green	Red and Brown	Red and Purple
	B (2)	Red and Black	Red and Green	Red and Brown
	C (3)	Red only	Red and Black	Red and Green
		Undersize bearing to be installed		

Rear oil seal



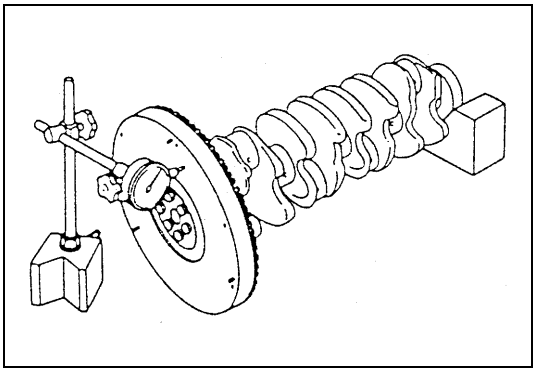
Carefully inspect oil seal (1) for wear or damage.
If its lip is worn or damaged, replace it.

Flywheel

Visual inspection

- If ring gear is damaged, cracked or worn, replace flywheel.
- If the surface contacting clutch disc is damaged, or excessively worn, replace flywheel.

Flywheel face runout



Check flywheel face runout with a dial gauge.
If runout exceeds its limit, replace flywheel.

Flywheel face runout
Limit : 0.2 mm (0.0079 in.)

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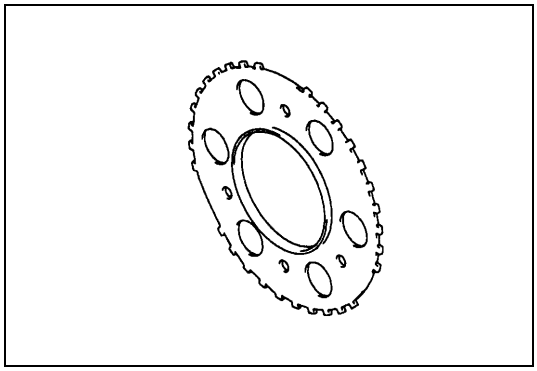
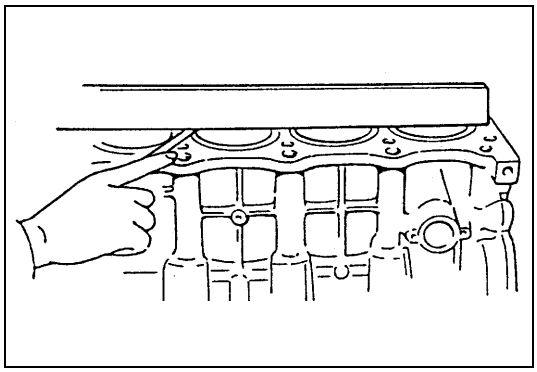
Sensor plate



Check sensor plate for crack or damage. If malcondition is found, replace it.

Cylinder block



Distortion of gasketed surface

Using straightedge and thickness gauge, check gasketed surface for distortion and, if flatness exceeds its limit, correct it.

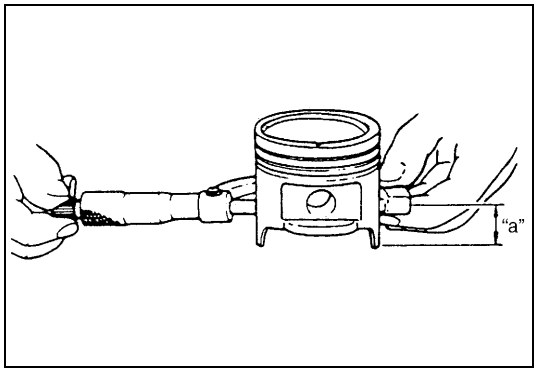
Cylinder block flatness
Limit: 0.03 mm (0.0012 in.)

Honing or reboring cylinders

1) When any cylinder needs reboring, all other cylinders must also be rebored at the same time.
2) Select oversized piston according to amount of cylinder wear.

Oversize piston diameter

Size	Piston diameter
Oversize 0.50	78.453 - 78.468 mm (3.0887 - 3.0893 in.)



3) Using micrometer, measure piston diameter.

Measurement position for piston diameter
"a": 5.0 mm (0.20 in.)

4) Rebore and hone cylinder to the following dimension.

Cylinder bore diameter to be rebored
Oversize 0.50: 78.500 – 78.514 mm (3.0906 – 3.0911 in.)

NOTE:

Before reboring, install all main bearing caps in place and tighten to specification to avoid distortion of bearing bores.

5) Measure piston clearance after honing.

Piston clearance: 0.032 – 0.061 mm (0.0013 – 0.0024 in.)

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Required Service Material

Material	Recommended SUZUKI product (Part Number)	Use
Sealant	Sealant 1207F (99000-31250)	• To apply to mating surfaces of cylinder block and oil pan. • To apply to mating surfaces of cylinder block and timing chain cover. • To apply to sealing surfaces of cylinder head cover. • To apply to mating surfaces to rear oil seal housing.
	Sealant 1207B (99000-31140)	• To apply to mating surface of cylinder block, cylinder head and timing chain cover.
	Sealant 1215 (99000-31110)	• To apply to the thread of the bolt of water outlet pipe.

Tightening Torque Specification

Fastening part	Tightening torque		
	N•m	kg-m	lb-ft
Oil pressure switch	14	1.4	10.5
Camshaft housing bolt (for replacement of shim)	8	0.8	6.0
Camshaft housing bolt	Tighten 11 N·m (1.1 kg-m, 8.0 lb-ft) by the specified procedure		
Cylinder head cover bolt	Tighten 8 N·m (0.8 kg-m, 6.0 lb-ft) by the specified procedure		
Intake manifold bolt and nut	25	2.5	18.0
Exhaust manifold bolt and nut	50	5.0	36.5
Exhaust pipe No.1 bolt	50	5.0	36.5
Exhaust manifold stiffener bolt	50	5.0	36.5
Exhaust pipe No.2 bolt	43	4.3	31.5
Exhaust oxygen sensor	45	4.5	32.5
Oil pump strainer bolt	11	1.1	8.0
Oil pump strainer bracket bolt	11	1.1	8.0
Oil pan bolt and nut	Tighten 11 N·m (1.1 kg-m, 8.0 lb-ft) by the specified procedure		
Oil pan drain plug bolt	50	5.0	36.5
Timing chain cover bolt	23	2.3	17.0
Crank shaft pulley bolt	150	15.0	108.5
Oil pump rotor plate bolt	11	1.1	8.0
Timing chain No.1 guide bolt	9	0.9	6.5
Timing chain tensioner adjuster bolt	11	1.1	8.0
Venturi plug	5	0.5	3.5
Cylinder head bolt for M8	Tighten 25 N·m (2.5 kg-m, 18.0 lb-ft) by the specified procedure		
Cylinder head bolt for M10	Tighten 20 N·m (2.0 kg-m, 14.5 lb-ft), 40 N·m (4.0 kg-m, 29.0 lb-ft), 60 ° and 60 ° by the specified procedure		
Connecting rod bearing cap nut	Tighten 15 N·m (1.5 kg-m, 11.0 lb-ft) 45 ° and 45 ° by the specified procedure		
Engine mounting bolt for M8	25	2.5	18.0
Engine mounting bolt and nut for M10	55	5.5	40.0
Engine right mounting nut	65	6.5	47.0

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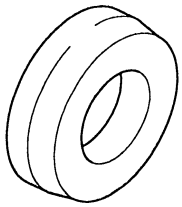
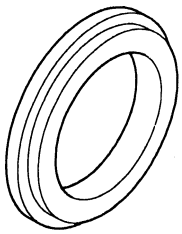
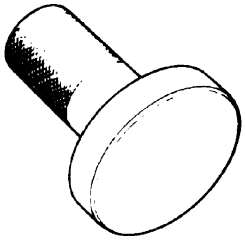
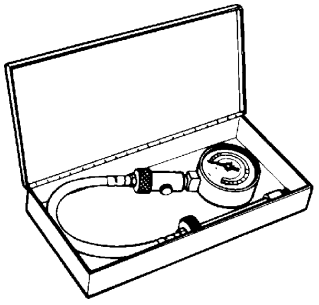
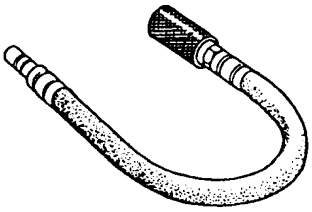
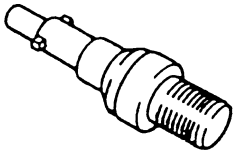
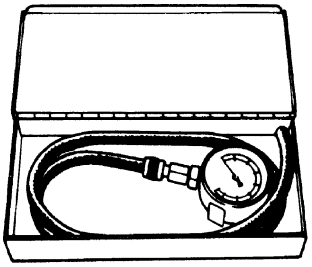
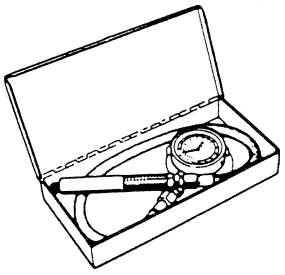
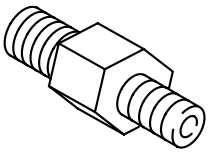
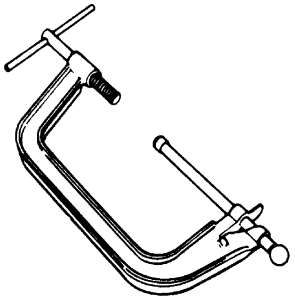
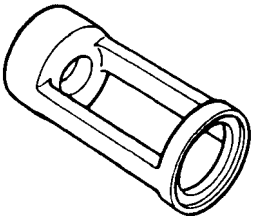
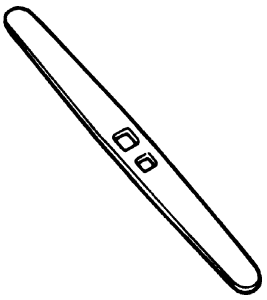
Fastening part	Tightening torque		
	N•m	kg-m	lb-ft
Main bearing cap No.1 bolt	Tighten 30 N·m (3.0 kg-m, 22.0 lb-ft), 50 N·m (5.0 kg-m, 36.5 lb-ft), and 60 ° by the specified procedure		
Main bearing cap No.2 bolt	Tighten 25 N·m (2.5 kg-m, 18.0 lb-ft) by the specified procedure		
Sensor plate bolt	11	1.1	8.0
Rear oil seal housing bolt	11	1.1	8.0
Flywheel or drive plate bolt	70	7.0	51.0
Transaxle stiffener bolt	Tighten 50 N·m (5.0 kg-m, 36.5 lb-ft) by the specified procedure		
Timing chain tensioner bolt	25	2.5	18.0
Oil gallery pipe No.1 bolt	30	3.0	21.5
Oil gallery pipe No.2 bolt	11	1.1	8.0
Oil gallery pipe No.3 bolt	11	1.1	8.0
Oil control valve mounting nut	11	1.1	8.0
Intake camshaft sprocket bolt	60	6.0	43.0

Special Tool

 09911-97720 Oil seal guide	 09911-97820 Oil seal installer	 09913-75810 Bearing installer	 09915-64512 Compression gauge
 09915-64530 Hose	 09915-67010 Attachment	 09915-67311 Vacuum gauge	 09915-77311 Oil pressure gauge
 09915-78211 Oil pressure gauge attachment	 09916-14510 Valve lifer	 09916-14521 Valve lifer attachment	 09916-34542 Reamer handle

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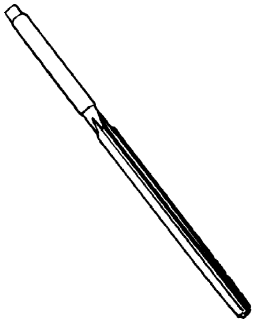
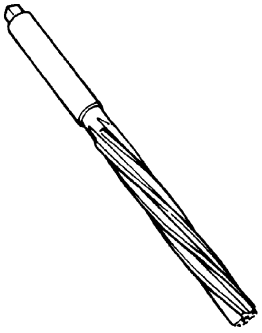
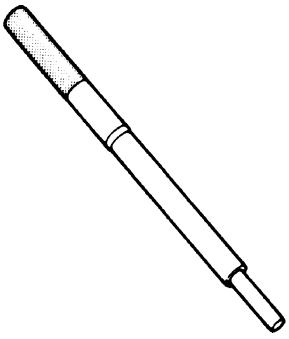
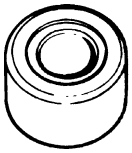
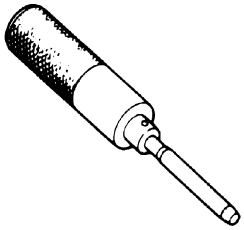
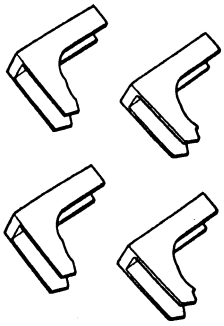
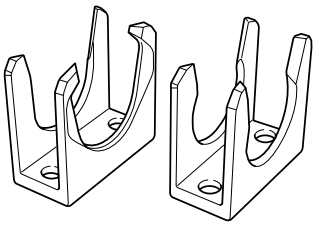
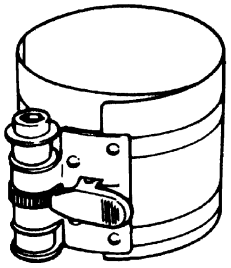
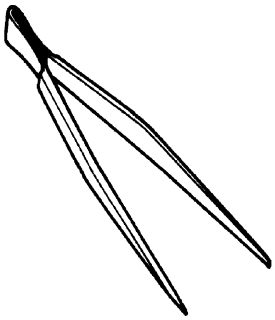
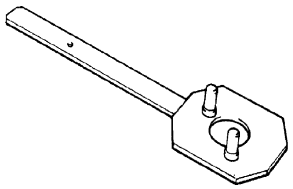
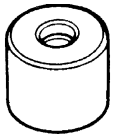
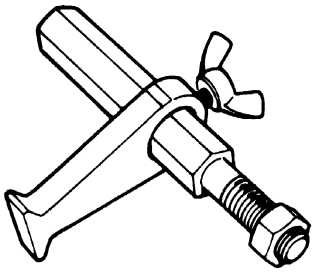
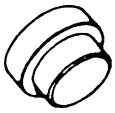
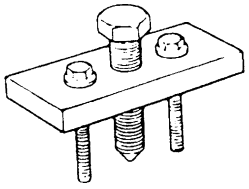
 09916-34550 Reamer (5.5 mm)	 09916-37320 Reamer (10.5 mm)	 09916-44910 Valve guide remover	 09916-56011 Valve guide installer
 09916-58210 Valve guide installer handle	[A]  09916-67020 Tappet holder See NOTE below	[B]  09916-67021 Tappet holder	 09916-77310 Piston ring compressor
 09916-84511 Forceps	 09917-68221 Camshaft lock holder	 09917-98221 Valve stem seal installer	 09924-17811 Flywheel holder
 09926-58010 Bearing puller attachment	 09944-36011 Steering wheel remover		

NOTE:

[A] and [B] tools in the above table are interchangeable.

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SECTION 6B

ENGINE COOLING

NOTE:

For the items with asterisk (*) in the "CONTENTS" below, refer to the same section of the Service Manual mentioned in "FOREWORD" of this manual.

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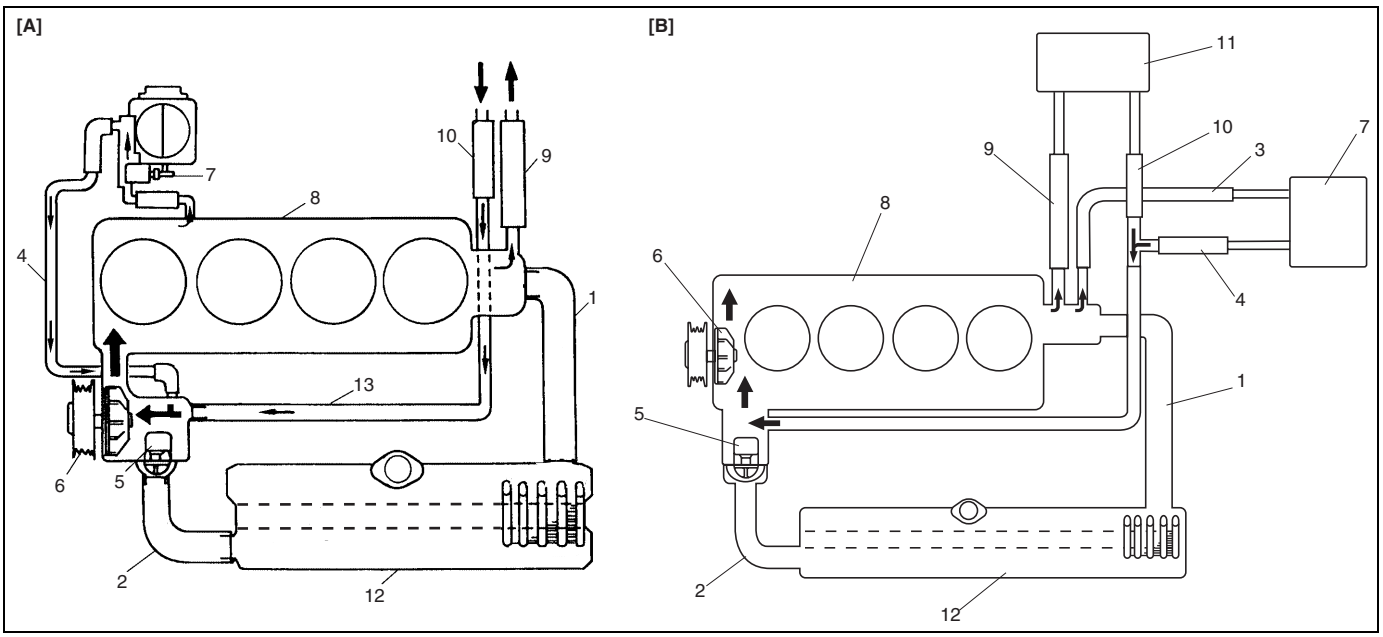
General Description

The cooling system consists of the radiator cap, radiator, coolant reservoir tank, hoses, water pump, cooling fan and thermostat. The radiator is of tube-and-fin type.

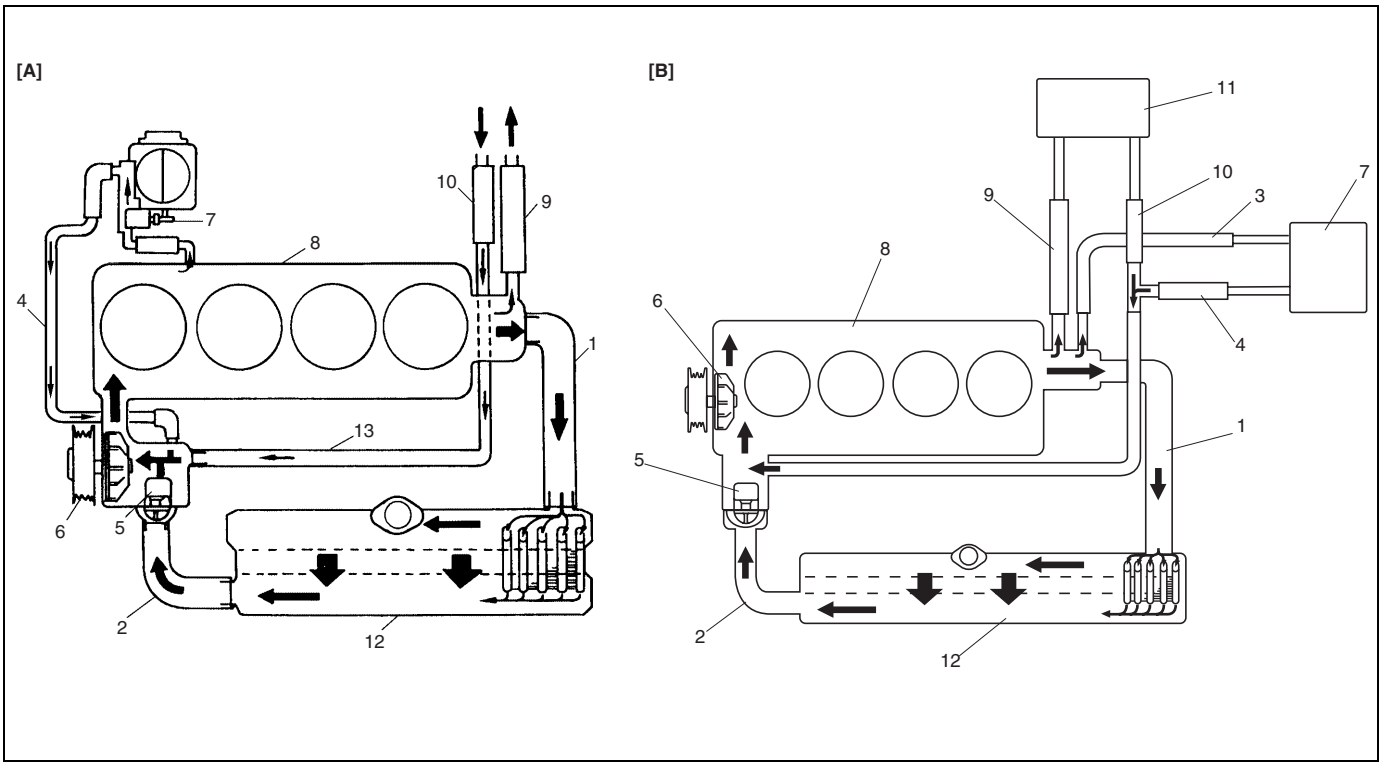
Cooling System Circulation

While the engine is warmed up (thermostat closed), coolant circulates as follows.



[A]: M13 engine model	3. Throttle body inlet hose	7. Throttle body	11. Heater core
[B]: M15 engine model	4. Throttle body outlet hose	8. Engine	12. Radiator
1. Radiator inlet hose	5. Thermostat	9. Heater core inlet hose	13. Water inlet pipe
2. Radiator outlet hose	6. Water pump	10. Heater core outlet hose	

When coolant is warmed up to normal temperature and the thermostat opens, coolant passes through the radiator core to be cooled as well as the above flow circuit.



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[A]: M13 engine model	3. Throttle body inlet hose	7. Throttle body	11. Heater core
[B]: M15 engine model	4. Throttle body outlet hose	8. Engine	12. Radiator
1. Radiator inlet hose	5. Thermostat	9. Heater core inlet hose	13. Water inlet pipe
2. Radiator outlet hose	6. Water pump	10. Heater core outlet hose	

Coolant

The coolant recovery system is standard. The coolant in the radiator expands with heat, and the coolant is overflowed to the reservoir.
When the system cools down, the coolant is drawn back into the radiator.

The cooling system has been filled with a quality coolant that is a 50/50 mixture of water and ethylene glycol antifreeze.

This 50/50 mixture coolant solution provides freezing protection to –36°C (–33°F).

- Maintain cooling system freeze protection at –36°C (–33°F) to ensure protection against corrosion and loss of coolant from boiling. This should be done even if freezing temperatures are not expected.
- Add ethylene glycol base coolant when coolant has to be added because of coolant loss or to provide added protection against freezing at temperature lower than –36°C (–33°F).

NOTE:

- **Alcohol or methanol base coolant or plain water alone should not be used in cooling system at any time as damage to cooling system could occur.**
- **Coolant must be mixed with demineraled water or distilled water.**

Anti-freeze proportioning table

		For M/T model	For A/T model
Freezing temperature	**°C**	**–36**	**–36**
	°F	**–33**	**–33**
Anti-freeze/Anti-corrosion coolant concentration	**%**	**50**	**50**
Ratio of compound to cooling water	**ltr.**	**2.49/2.49**	**2.39/2.39**
	US pt.	**5.31/5.31**	**5.10/5.10**
	Imp pt.	**4.38/4.38**	**4.21/4.21**

Coolant capacity

	For M/T model	For A/T model
Engine radiator and heater	**4.6 liters (9.81/8.10 US/Imp. pt.)**	**4.4 liters (9.39/7.74 US/Imp. pt.)**
Reservoir	**0.38 liters (0.81/0.67 US/Imp. pt.)**	**0.38 liters (0.81/0.67 US/Imp. pt.)**
Total	**4.98 liters (10.62/8.76 US/Imp. pt.)**	**4.78 liters (10.20/8.41 US/Imp. pt.)**

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Maintenance

WARNING:

- **Do not remove radiator cap to check engine coolant level; check coolant visually at the see-through coolant reservoir.**
  Coolant should be added to reservoir as necessary.
- **As long as there is pressure in the cooling system, the temperature can be considerably higher than the boiling temperature of the solution in the radiator without causing the solution to boil. Removal of the radiator cap while engine is hot and pressure is high will cause the solution to boil instantaneously and possibly with explosive force, spewing the solution over engine, fenders and person removing cap. If the solution contains flammable anti-freeze such as alcohol (not recommended for use at any time), there is also the possibility of causing a serious fire.**

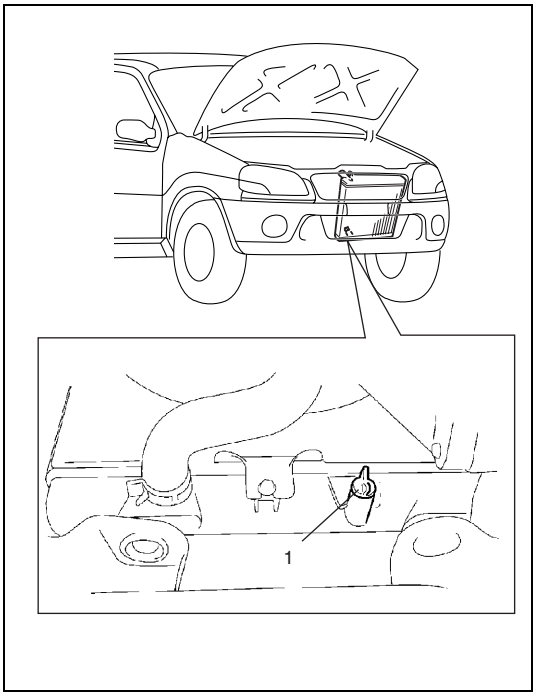
Cooling System Flush and Refill (for M13 Engine Model)

1) Remove radiator cap when engine is cool.
   a) Turn cap counterclockwise slowly until it reaches a “stop”. (Do not press down while turning it).
   b) Wait until pressure is relieved (indicated by a hissing sound) then press down on cap and continue to turn it counterclockwise.

WARNING:

To help avoid danger of being burned, do not remove radiator cap while engine and radiator are still hot.
Scalding fluid and steam can be blown out under pressure if cap is taken off too soon.

2) With radiator cap removed, run engine until upper radiator hose is hot (this shows that thermostat is open and coolant is flowing through system).



3) Stop engine and drain coolant.
4) Close drain plug. Add water until system is filled and run engine until upper radiator hose is hot again.
5) Repeat Steps 3) and 4) several times until drained liquid is nearly colorless.
6) Drain system and then close radiator drain plug (1) tightly.

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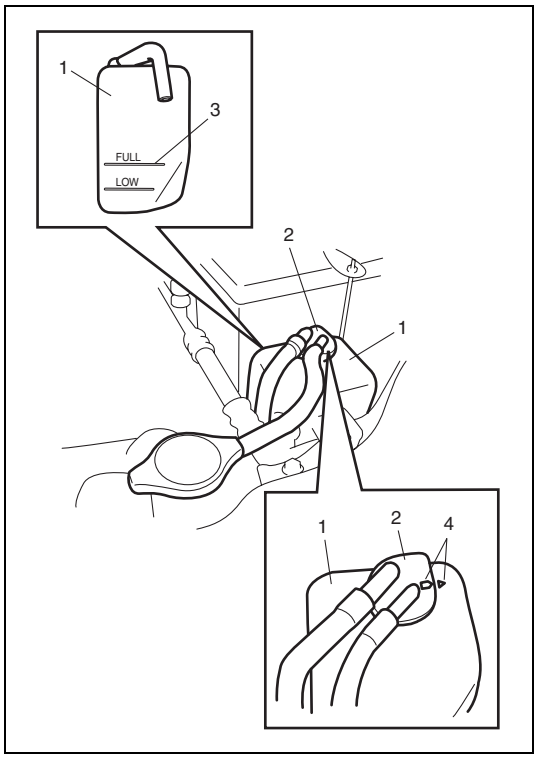

7) Remove reservoir tank (1) and remove cap (2) from reservoir tank (1) and pour out any fluid, scrub and clean inside of tank with soap and water.
   Flush it well with clean water and drain. Reinstall tank.
8) Add coolant that is a mixture of good quality ethylene glycol antifreeze and water to radiator and reservoir tank. For coolant concentration referring to “Coolant”.
   Fill radiator to the bottom of filler neck and reservoir tank to FULL level mark (3).
9) Reinstall reservoir tank cap and align match marks (4) on reservoir tank and its tank cap.
10) Run engine with radiator cap removed, until radiator inlet hose is hot.
11) With engine idling, add coolant to radiator until level reaches the bottom of filler neck. Install radiator cap, making sure that the ear of cap lines is parallel to radiator.

Cooling System Flush and Refill (for M15 Engine Model)

WARNING:

To help avoid danger of being burned, do not remove radiator cap while engine and radiator are still hot.
Scalding fluid and steam can be blown out under pressure if cap is taken off too soon.

NOTE:

For detail of coolant specification, refer to “Coolant” in this section.

1) Remove radiator cap when engine is cool as follows.
   a) Turn cap counterclockwise slowly until it reaches a “stop”. (Do not press down while turning it).
   b) Wait until pressure is relieved (indicated by a hissing sound) then press down on cap and continue to turn it counterclockwise.
2) With radiator cap removed, run engine until upper radiator hose is hot (this shows that thermostat is open and coolant is flowing through system).

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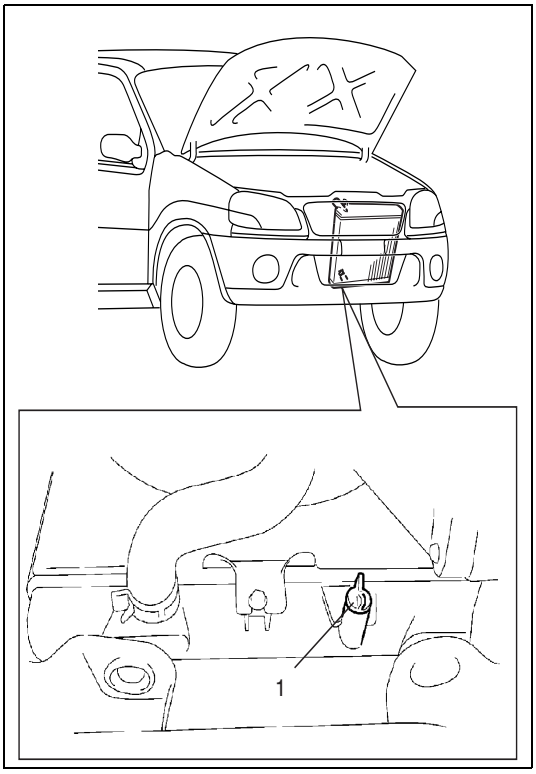
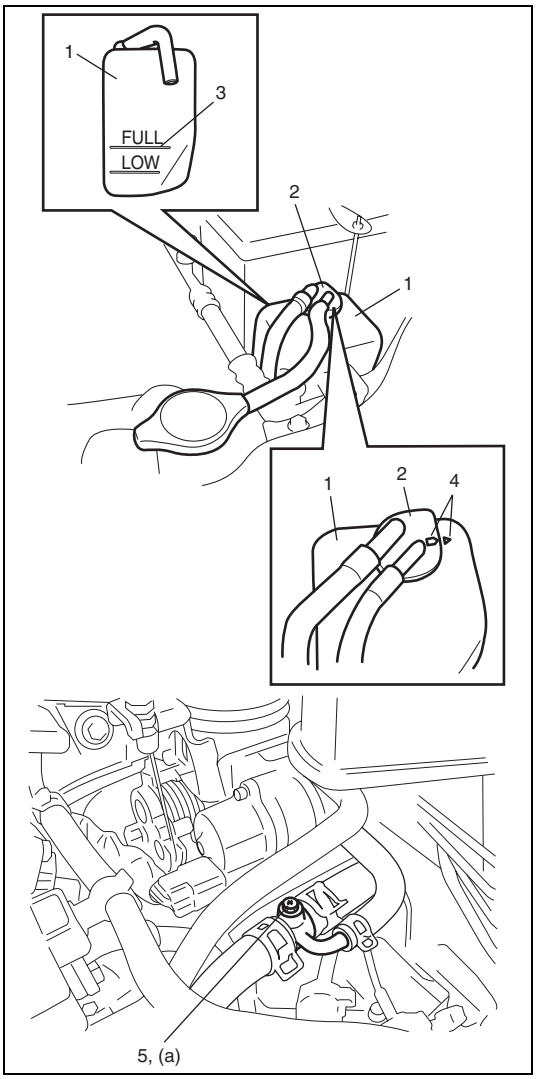


3) Stop engine and drain coolant from radiator drain plug (1).
4) Close radiator drain plug (1). Add water until system is filled and run engine until upper radiator hose is hot again.
5) Repeat Steps 3) and 4) several times until drained liquid is nearly colorless.
6) Close radiator drain plug (1) tightly.



7) Remove reservoir (1), and remove cap (2) from reservoir (1).
8) Pour out any fluid, scrub and clean inside of reservoir with soap and water.
   Flush it well with clean water and drain. Reinstall reservoir.
9) Fill reservoir with coolant up to “Full” level mark (3).
10) Install reservoir cap (2) and align match marks (4) on reservoir and its cap.
11) Loosen air ventilation bolt (5) one and a half turns.
12) Fill radiator with coolant up to spilling coolant from air ventilation bolt (5).
13) Tighten air ventilation bolt (5) to specified torque.

Tightening torque
Air ventilation bolt (a): 4.5 N·m (0.45 kg-m, 3.5 lb-ft)

14) Fill radiator with coolant up to bottom of radiator filler neck and install radiator cap, making sure that the ear of cap lines is parallel to radiator.
15) Run engine at idle speed.
16) Loosen air ventilation bolt (5) one and a half turns.
17) Run engine at 2000-3000 rpm, and tighten air ventilation bolt (5) to specified torque after spilling coolant from air ventilation bolt (5).

Tightening torque
Air ventilation bolt (a): 4.5 N·m (0.45 kg-m, 3.5 lb-ft)

18) Run engine until radiator fan motor is operated.
19) Stop engine and wait until engine comes cooled down to help avoid danger of being burned.

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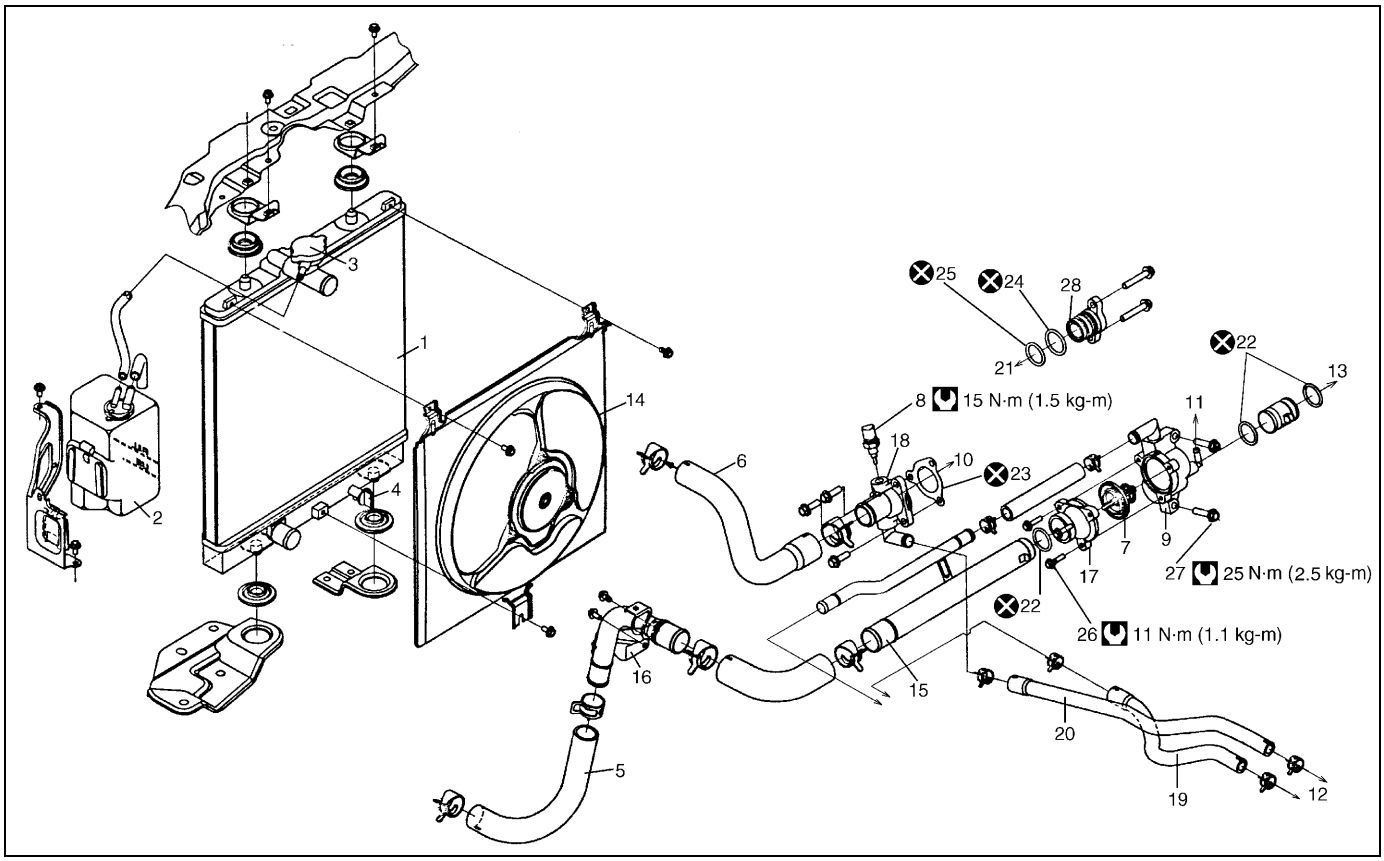
20) Add coolant to radiator up to bottom of radiator filler neck, and install radiator cap, making sure that the ear of cap lines is parallel to radiator.
21) Repeat step 15) through 20).
22) Confirm that reservoir coolant level is “Full” level mark (3). If coolant is insufficient, repeat step 9) and 10).

On-Vehicle Service

WARNING:
- **Check to make sure that engine coolant temperature is cold before removing any part of cooling system.**
- **Also be sure to disconnect negative cord from battery terminal before removing any part.**

System Components

M13 engine model



1. Radiator	11. To throttle body	21. To timing chain cover
2. Reservoir tank	12. To heater unit	22. O-ring
3. Radiator cap	13. To water pump	23. Gasket
4. Drain plug	14. Radiator and condenser cooling fan assembly	24. Water outlet cap O-ring No.1
5. Radiator outlet hose	15. Water inlet pipe No.1	25. Water outlet cap O-ring No.2
6. Radiator inlet hose	16. Water inlet pipe No.2	26. Thermostat cap bolts
7. Thermostat	17. Thermostat cap	27. Thermostat case bolts
8. ECT sensor	18. Water outlet cap	28. Water outlet plug
9. Thermostat case	19. Heater inlet hose	Tightening torque
10. To cylinder head	20. Heater outlet hose	Do not reuse.

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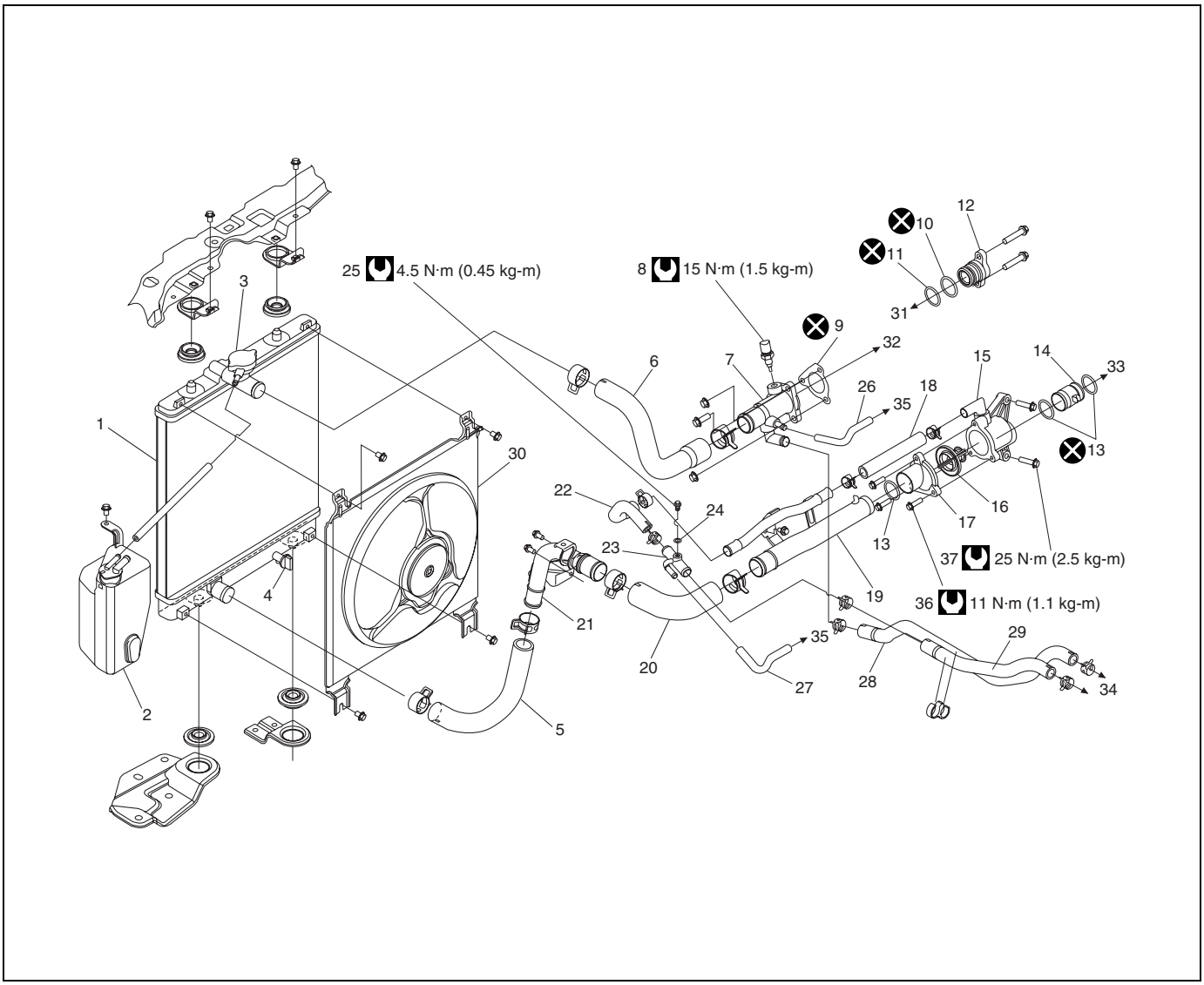
M15 engine model



1. Radiator	14. Thermostat case water outlet pipe	27. Throttle body outlet hose
2. Reservoir	15. Thermostat case	28. Heater core inlet hose
3. Radiator cap	16. Thermostat	29. Heater core outlet hose
4. Drain plug	17. Thermostat cap	30. Radiator cooling fan assembly
5. Radiator outlet hose	18. Water bypass hose	31. To timing chain cover
6. Radiator inlet hose	19. Water inlet pipe No.1	32. To cylinder head
7. Water outlet cap	20. Water inlet hose	33. To water pump
8. ECT sensor	21. Water inlet pipe No.2	34. To heater core
9. Gasket	22. Heater outlet hose No.2	35. To throttle body
10. Water outlet cap O-ring No.1	23. Heater union	36. Thermostat cap bolt
11. Water outlet cap O-ring No.2	24. Heater union gasket	37. Thermostat case bolt
12. Water outlet plug	25. Air ventilation bolt	Tightening torque
13. O-ring	26. Throttle body inlet hose	Do not reuse.

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Tightening Torque Specification

Fastening part	Tightening torque		
	N•m	kg-m	lb-ft
Air ventilation bolt	4.5	0.45	3.5
Generator adjusting bolt	23	2.3	17
Generator pivot bolt	50	5	36
Water pump bolt and Nuts	22	2.2	16

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SECTION 6E2

ENGINE AND EMISSION CONTROL SYSTEM (M15 ENGINE)

WARNING:

For vehicles equipped with Supplemental Restraint (Air Bag) System :

- **Service on and around the air bag system components or wiring must be performed only by an authorized SUZUKI dealer. Refer to "Air Bag System Components and Wiring Location View" under "General Description" in Section 10B in order to confirm whether you are performing service on or near the air bag system components or wiring. Please observe all WARNINGS and "Service Precautions" under "On-Vehicle Service" in Section 10B before performing service on or around the air bag system components or wiring. Failure to follow WARNINGS could result in unintentional activation of the system or could render the system inoperative. Either of these two conditions may result in severe injury.**
- **Technical service work must be started at least 90 seconds after the ignition switch is turned to the "LOCK" position and the negative cable is disconnected from the battery. Otherwise, the system may be activated by reserve energy in the Sensing and Diagnostic Module (SDM).**

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General Description

Engine and Emission Control System Construction

The engine and emission control system is divided into 4 major sub-systems: air intake system, fuel delivery system, electronic control system and emission control system.
Air intake system includes air cleaner, throttle body, IAC valve and intake manifold.
Fuel delivery system includes fuel pump, delivery pipe, etc. Electronic control system includes ECM, various sensors and controlled devices.
Emission control system includes EGR, EVAP and PCV system.

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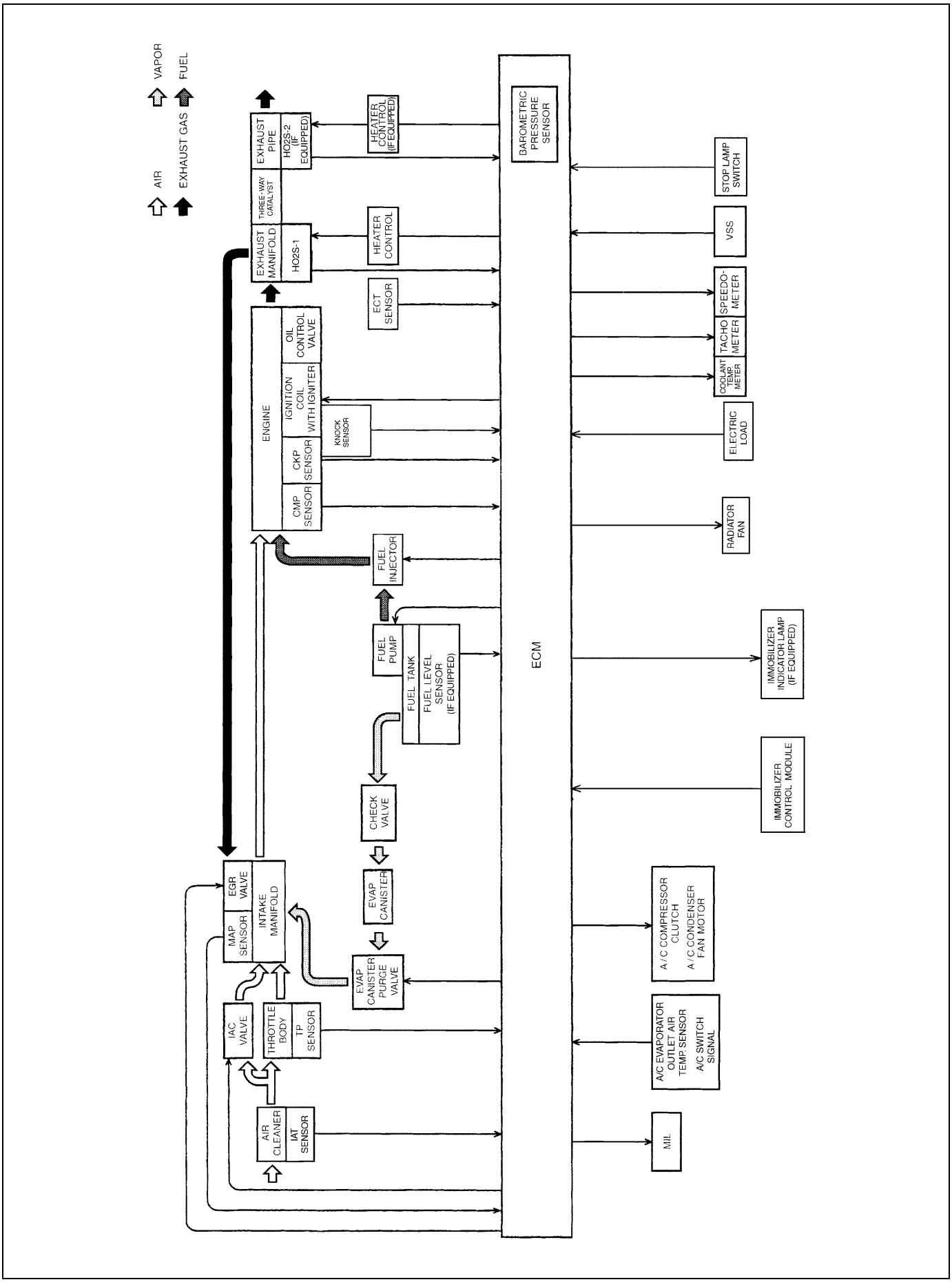
Engine and Emission Control System Flow Diagram



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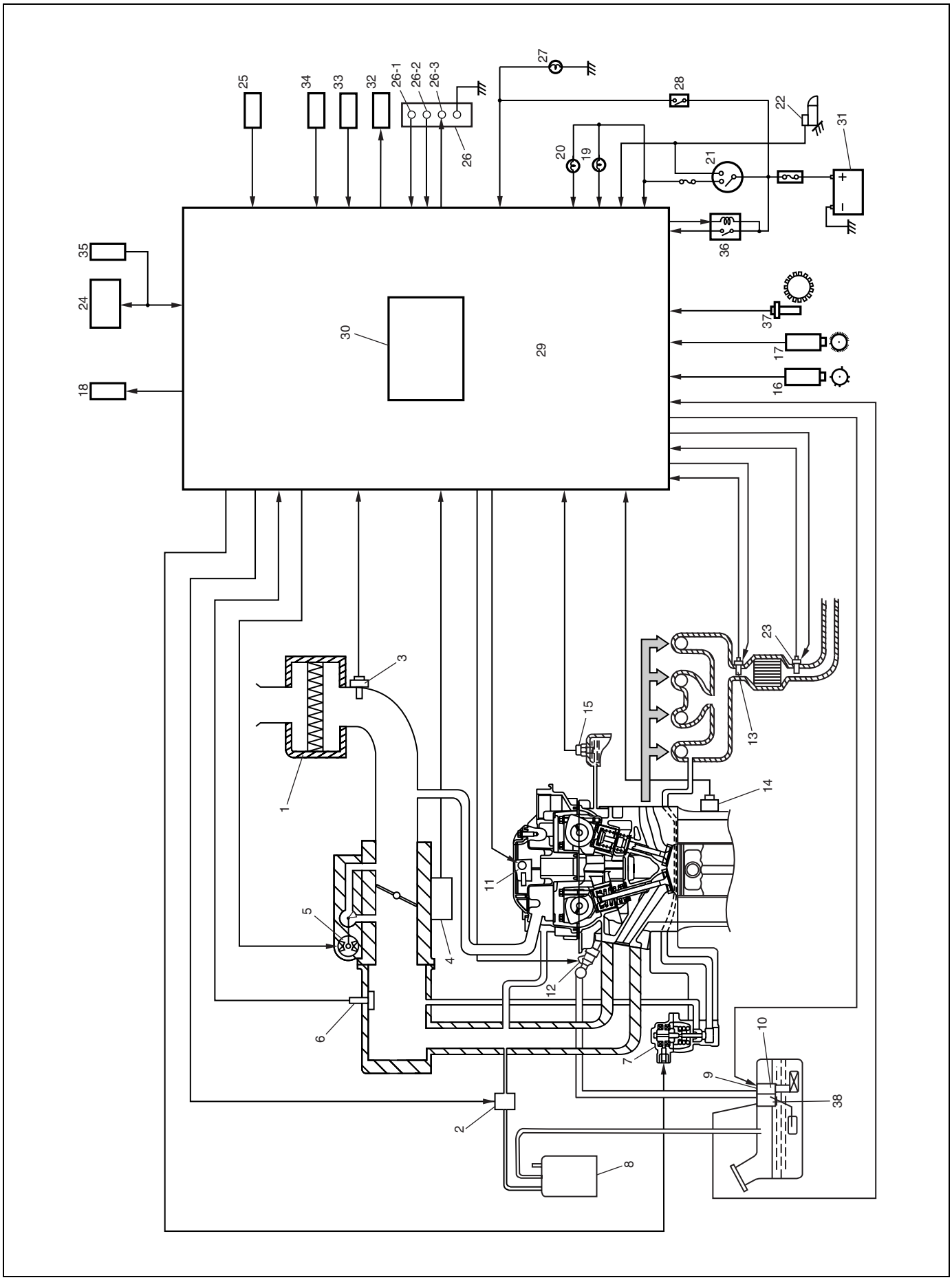
Engine and Emission Control System Diagram



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1. Air Cleaner	15. ECT sensor	26-3. Duty output terminal
2. EVAP canister purge valve	16. CMP sensor	27. Stop lamp
3. IAT sensor	17. CKP sensor	28. Stop lamp switch
4. TP sensor	18. Radiator fan	29. ECM
5. IAC valve	19. Malfunction indicator lamp in combination meter	30. Barometric pressure sensor
6. MAP sensor	20. Immobilizer indicator lamp in combination meter (if equipped)	31. Battery
7. EGR valve	21. Ignition switch	32. A/C compressor and condenser fan relay (if equipped)
8. EVAP canister	22. Starter magnetic switch	33. A/C switch (if equipped)
9. Tank pressure control valve (built-in fuel pump)	23. Heated Oxygen Sensor–2 (HO2S–2) (if equipped)	34. A/C evaporator outlet air temp. sensor (if equipped)
10. Fuel pump (with pressure regulator)	24. DLC	35. Immobilizer control module
11. Ignition coil assembly	25. Electric load	36. Main relay
12. Fuel injector	26. Monitor connector (if equipped)	37. VSS
13. Heated Oxygen Sensor–1 (HO2S–1)	26-1. Diagnosis switch terminal	38. Fuel level sensor
14. Knock sensor	26-2. Test switch terminal	

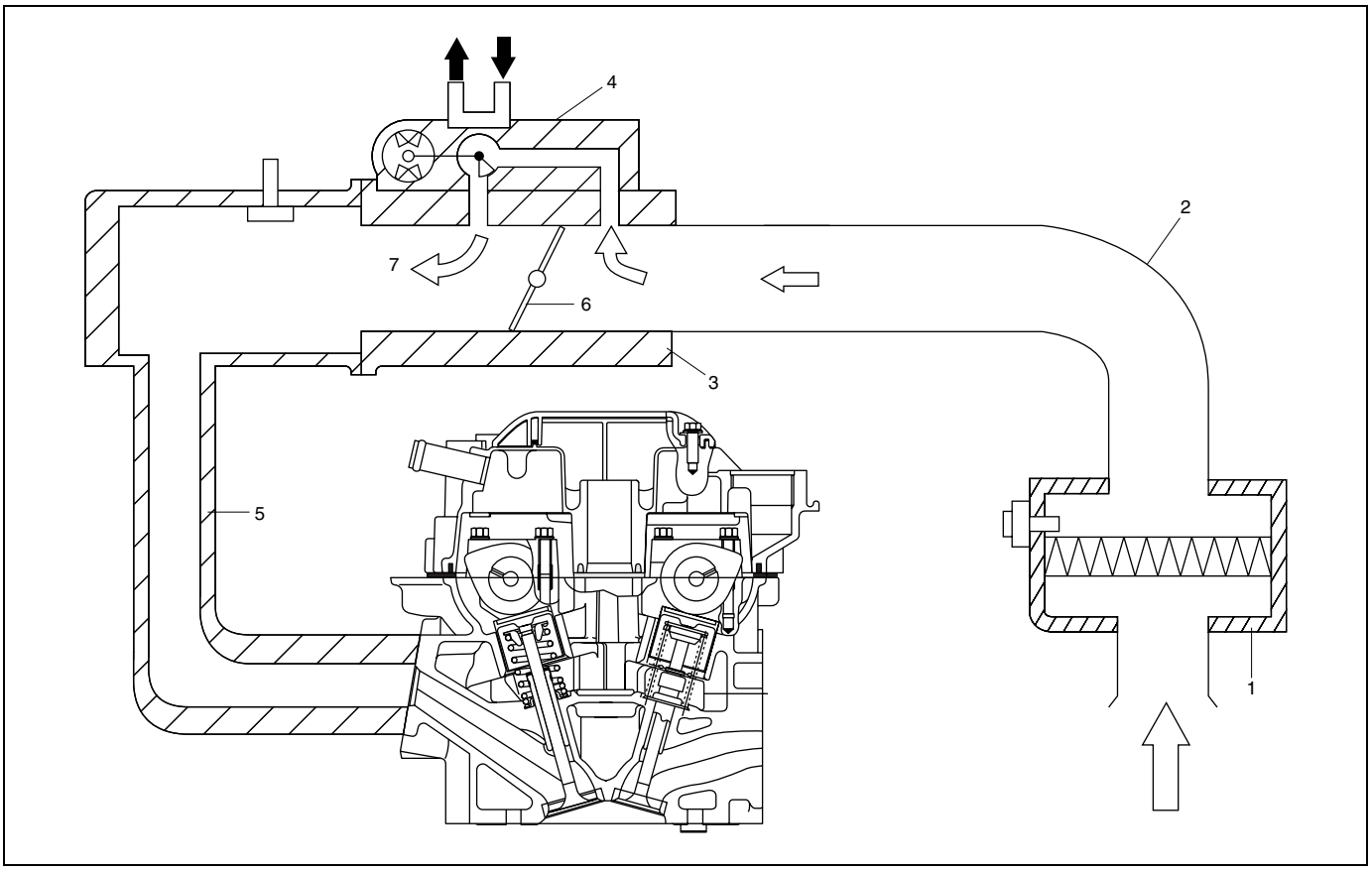
Air Intake System Description

The main components of the air intake system are air cleaner (1), air cleaner outlet hose (2), throttle body (3), idle air control valve (4) and intake manifold (5).

The air (by the amount corresponding to the throttle valve (6) opening and engine speed) is filtered by the air cleaner (1), passes through the throttle body (3), is distributed by the intake manifold (5) and finally drawn into each combustion chamber.

When the idle air control valve (4) is opened according to the signal from ECM, the air (7) bypasses the throttle valve (6) through bypass passage and is finally drawn into the intake manifold (5).

Air Intake System Diagram



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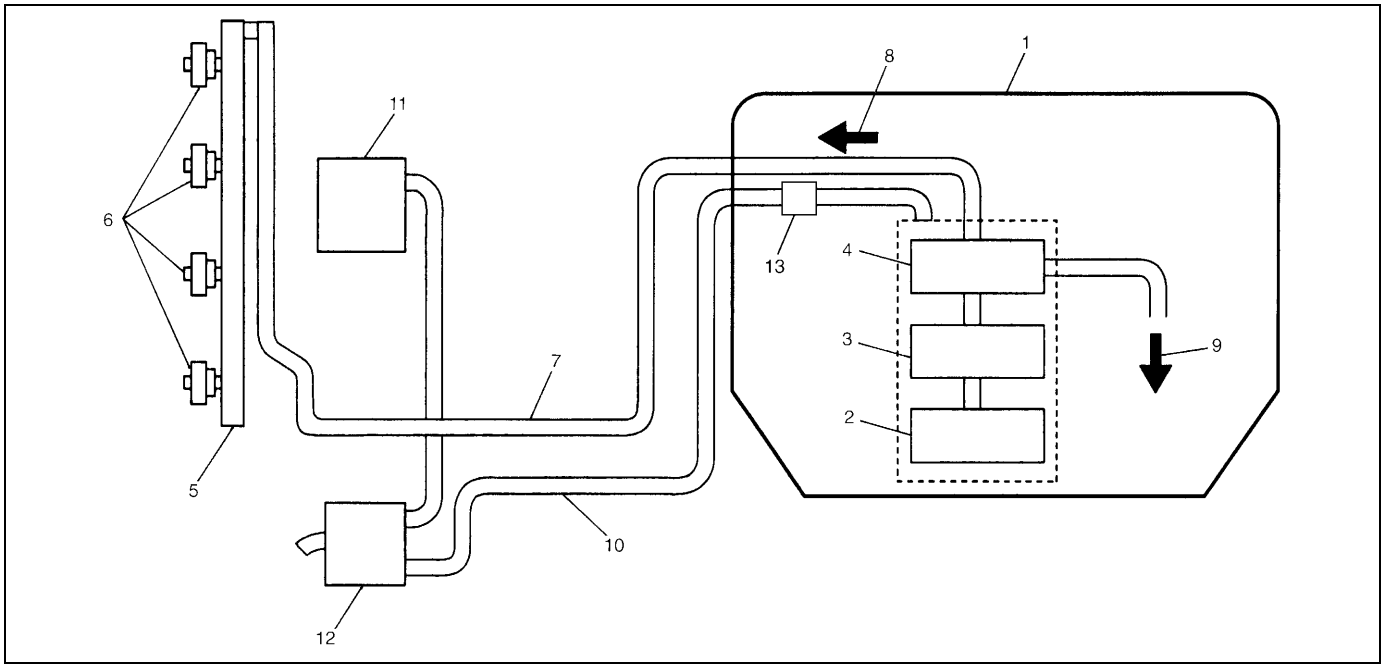
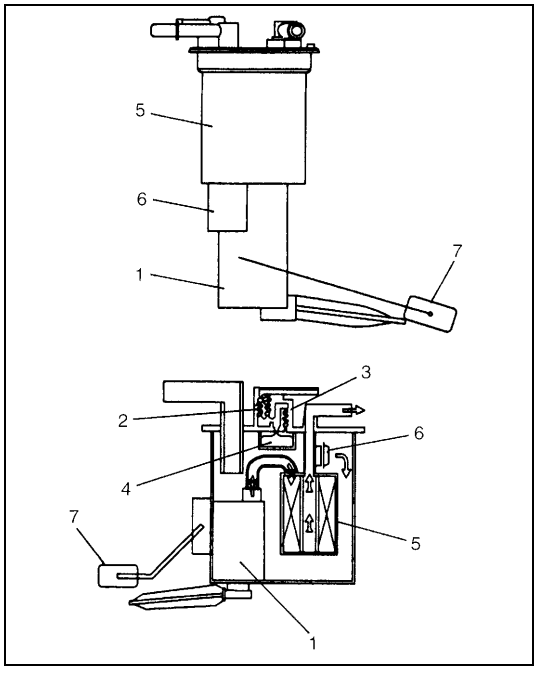
Fuel Delivery System Description

The fuel system consists of fuel tank (1), fuel pump (2) (with built-in fuel filter (3) and fuel pressure regulator (4)), delivery pipe (5), injectors (6) and fuel feed line (7).
The fuel (8) in the fuel tank (1) is pumped up by the fuel pump (2), sent into delivery pipe (5) and injected by the injectors (6).
As the fuel pump assembly is equipped with built-in fuel filter (3) and fuel pressure regulator (4), the fuel (8) is filtered and its pressure is regulated before being sent to the delivery pipe (5).
The excess fuel from fuel pressure regulation process is returned back (9) into the fuel tank.
Also, fuel vapor generated in fuel tank is led through the fuel vapor line (10) into the EVAP canister (12).

Fuel Delivery System Diagram



11. Intake manifold	13. Fuel vapor separator



Fuel Pump

An in-tank type electric pump has been adopted for the fuel pump (1). Incorporated in the pump assembly are;

- Tank pressure control valve (2) which keeps the pressure in the fuel tank constant, and prevents the fuel from spouting and tank itself from being deformed.
- Relief valve (3) which prevents the pressure in tank from rising excessively.
- Fuel cut valve (4) which closes as the float rises so that the fuel will not enter the canister when the fuel level in the tank rises high depending on the fuel level in the tank and the vehicle tilt angle.

Also, a fuel filter (5) and a fuel pressure regulator (6) are included and a fuel level gauge (7) is attached.
Addition of the fuel pressure regulator (6) to the fuel pump makes it possible to maintain the fuel pressure at constant level and ECM controls compensation for variation in the intake manifold pressure.

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Electronic Control System Description

The electronic control system consists of 1) various sensors which detect the state of engine and driving conditions, 2) ECM which controls various devices according to the signals from the sensors and 3) various controlled devices.

Functionally, it is divided into nine sub systems:

- Fuel injection control system
- Idle speed control system
- Fuel pump control system
- A/C control system (if equipped)
- Radiator fan control system
- EGR system
- Evaporative emission control system
- Oxygen sensor heater control system
- Ignition control system
- Variable intake valve timing control system

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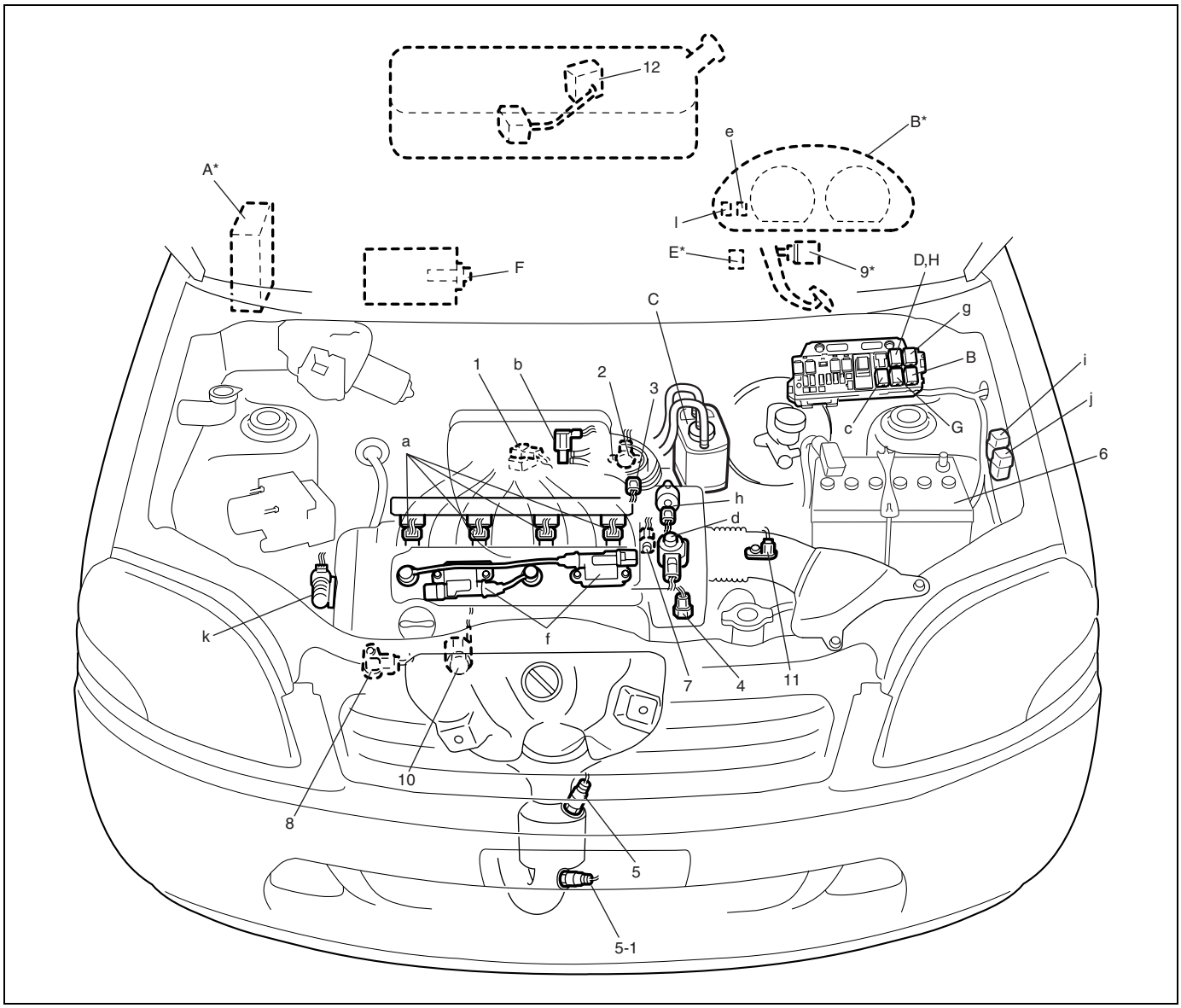
Electronic Control System Component Location



INFORMATION SENSORS	CONTROL DEVICES	OTHERS
1. MAP sensor	a: Fuel injector	A: ECM
2. TP sensor	b: EVAP canister purge valve	B: Main relay
3. IAT sensor	c: Fuel pump relay	C: EVAP canister
4. ECT sensor	d: EGR valve (step motor)	D: Monitor connector (if equipped)
5. Heated oxygen sensor–1	e: Malfunction indicator lamp	E: Data link connector
5-1. Heated oxygen sensor–2 (if equipped)	f: Ignition coil assembly	F: A/C EVAP outlet air temp. sensor (if equipped)
6. Battery	g: Radiator fan control relay No.1	G: A/C condenser fan relay (if equipped)
7. CMP sensor	h: IAC valve	H: A/C compressor relay (if equipped)
8. CKP sensor	i: Radiator fan control relay No.2	
9. Stop lamp switch	j: Radiator fan control relay No.3	
10. Knock sensor	k. Oil control valve	
11. VSS	l. Immobilizer indicator lamp (if equipped)	
12. Fuel level sensor		

NOTE:

Above figure shows left-hand steering vehicle. For right-hand steering vehicle, parts with (*) are installed at the opposite side.

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Engine & Emission Control Input/Output Table

	INPUT \ OUTPUT	ELECTRIC CONTROL DEVICE											
		FUEL PUMP RELAY	FUEL INJECTOR	HO2S HEATER	IAC VALVE	IGNITION COIL WITH IGNITER	EGR VALVE	EVAP CANISTER PURGE VALVE	A/C COMPRESSOR AND CONDENSER FAN RELAY	RADIATOR FAN RELAY	MIL	MAIN RELAY	OIL CONTROL VALVE
SIGNAL FROM SENSOR, SWITCH AND CONTROL MODULE	FUEL LEVEL SENSOR (if equipped)	For detecting fuel level											
	BAROMETRIC PRESSURE SENSOR		○		○	○		○			○		
	STOP LAMP SWITCH				○								
	START SWITCH	○	○	○	○		○		○		○		○
	IGNITION SWITCH	○	○	○	○	○	○	○	○	○		○	○
	LIGHTING SWITCH				○								
	BLOWER SWITCH				○				○				
	A/C SWITCH				○			○	○	○			
	A/C EVAP OUTLET AIR TEMP. SENSOR				○				○				
	VSS		○		○		○		○	○	○		○
	HEATED OXYGEN SENSOR-1		○					○			○		
	HEATED OXYGEN SENSOR-2 (if equipped)	For detecting deterioration of three way catalytic converter									○		
	IAT SENSOR		○		○	○	○	○			○		
	ECT SENSOR		○	○	○	○	○	○	○	○	○		○
	TP SENSOR		○		○	○	○	○	○		○		○
	MAP SENSOR		○	○	○	○	○	○	○		○		○
	CMP SENSOR	○	○			○					○		○
	CKP SENSOR	○	○	○	○	○	○	○	○		○		○
	KNOCK SENSOR					○					○		
	DIAGNOSIS SWITCH TERMINAL (if equipped)										○		
	TEST SWITCH TERMINAL (if equipped)					○							

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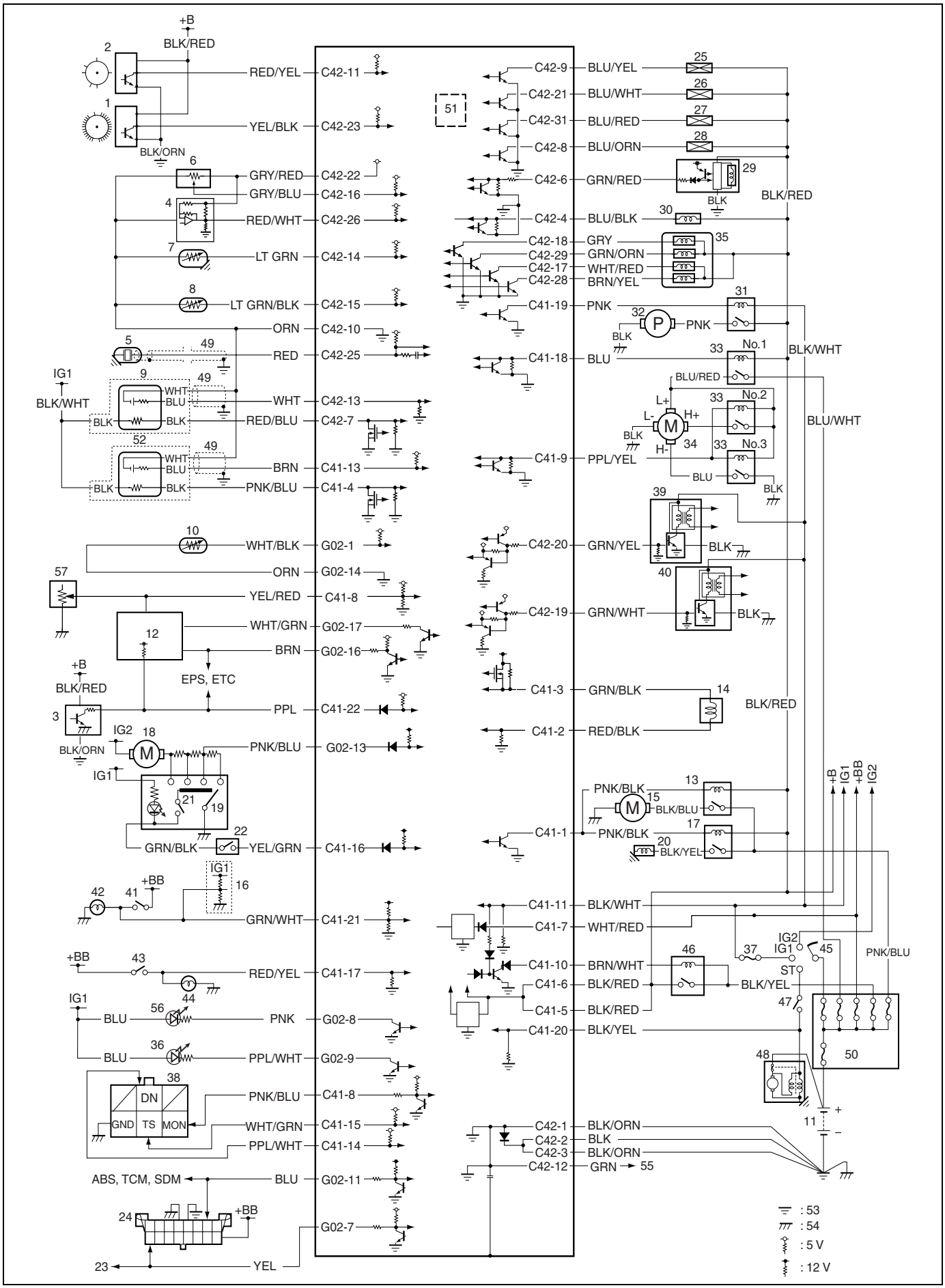
ECM Input/Output Circuit Diagram



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1. CKP sensor	20. A/C compressor clutch	39. Ignition coil assembly (for No.1 and No.4 spark plugs)
2. CMP sensor	21. A/C switch	40. Ignition coil assembly (for No.2 and No.3 spark plugs)
3. VSS	22. A/C pressure switch	41. Stop lamp switch
4. MAP sensor	23. Immobilizer control module	42. Stop lamp
5. Knock sensor	24. Data link connector	43. Lighting switch
6. TP sensor	25. Injector No.1	44. Position lamp
7. ECT sensor	26. Injector No.2	45. Ignition switch
8. IAT sensor	27. Injector No.3	46. Main relay
9. Heated oxygen sensor–1	28. Injector No.4	47. Clutch switch
10. A/C evaporator outlet air temp. sensor	29. IAC valve	48. Starting motor
11. Battery	30. EVAP canister purge valve	49. Shield wire
12. Combination meter	31. Fuel pump relay	50. Main fuse
13. A/C condenser fan relay	32. Fuel pump	51. Barometric pressure sensor
14. Oil control valve	33. Radiator fan relay	52. Heated oxygen sensor–2 (if equipped)
15. A/C condenser fan motor	34. Radiator fan motor	53. Engine ground
16. ABS control module	35. EGR valve	54. Body ground
17. A/C compressor relay	36. Malfunction indicator lamp	55. Shield ground
18. Heater fan motor	37. “IG” fuse	56. Immobilizer indicator lamp (if equipped)
19. Heater fan switch	38. Monitor connector (if equipped)	57. Fuel level sensor (if equipped)

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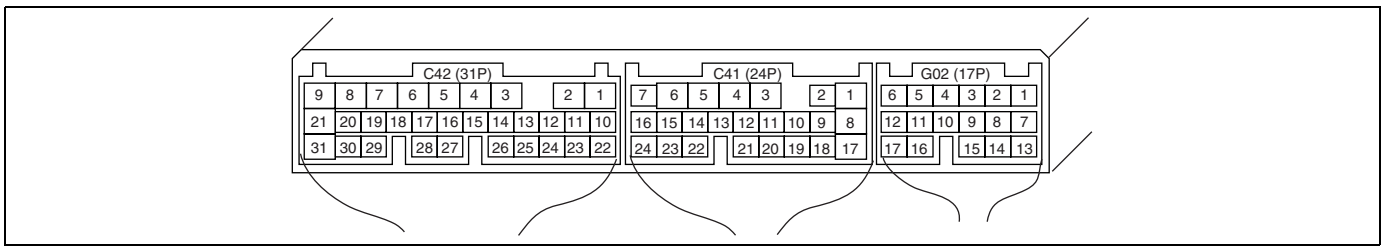
ECM Terminal Arrangement Table

CONNECTOR	TERMINAL	WIRE COLOR	CIRCUIT
C42	1	BLK/ORN	Ground for ECM
	2	BLK	Ground for drive circuit
	3	BLK/ORN	Ground for drive circuit
	4	BLU/BLK	Canister purge valve
	5	–	–
	6	GRN/RED	IAC valve
	7	RED/BLU	Heater of HO2S–1
	8	BLU/ORN	No.4 fuel injector
	9	BLU/YEL	No.1 fuel injector
	10	ORN	Ground for sensor circuit
	11	RED/YEL	CMP sensor
	12	GRN	Ground for ECM shield wire
	13	WHT	Heated oxygen sensor–1
	14	LT GRN	Coolant temp. sensor
	15	LT GRN/BLK	Intake air temp. sensor
	16	GRY/BLU	TP sensor
	17	WHT/RED	EGR valve (stepper motor coil 3)
	18	GRY	EGR valve (stepper motor coil 1)
	19	GRN/WHT	IG coil assembly for No.2 and 3 spark plugs
	20	GRN/YEL	IG coil assembly for No.1 and 4 spark plugs
	21	BLU/WHT	No.2 fuel injector
	22	GRY/RED	Power supply for sensor
	23	YEL/BLK	CKP sensor (+)
	24	–	–
	25	RED	Knock sensor
	26	RED/WHT	MAP sensor
	27	–	–
	28	BRN/YEL	EGR valve (stepper motor coil 4)
	29	GRN/ORN	EGR valve (stepper motor coil 2)
	30	–	–
	31	BLU/RED	No.3 fuel injector

CONNECTOR	TERMINAL	WIRE COLOR	CIRCUIT
C41	12	–	–
	13	BRN	Heated oxygen sensor–2
	14	PPL/WHT	Diagnosis switch terminal (if equipped)
	15	WHT/GRN	Test switch terminal (if equipped)
	16	YEL/GRN	A/C SW signal
	17	RED/YEL	Electric load (+)
	18	BLU	Radiator fan relay 1
	19	PNK	Fuel pump relay
	20	BLK/YEL	Engine start signal
	21	GRN/WHT	Stop lamp switch (Brake pedal switch)
	22	PPL	VSS
	23	–	–
	24	–	–
G02	1	WHT/BLK	A/C evaporator outlet air temp. sensor
	2	–	–
	3	–	–
	4	–	–
	5	–	–
	6	–	–
	7	YEL	Data link connector
	8	PNK	Immobilizer indicator lamp (if equipped)
	9	PPL/WHT	Malfunction indicator lamp
	10	–	–
	11	BLU	Data link connector
	12	–	–
	13	PNK/BLU	Electrical load (-)
	14	ORN	Ground for sensor
	15	–	–
	16	BRN	Tachometer signal
	17	WHT/GRN	Coolant temp. signal output

CONNECTOR	TERMINAL	WIRE COLOR	CIRCUIT
C41	1	PNK/BLK	A/C compressor clutch and condenser fan relay
	2	RED/BLK	Oil control valve (–)
	3	GRN/BLK	Oil control valve (+)
	4	PNK/BLU	Heater of HO2S–2
	5	BLK/RED	Power source
	6	BLK/RED	Power source
	7	WHT/RED	Back up power source
	8	YEL/RED	Fuel level gauge (if equipped)
		PNK/BLU	Duty output terminal (if equipped)
	9	PPL/YEL	Radiator fan relay 2
	10	BRN/WHT	Ground for main relay
	11	BLK/WHT	Ignition switch signal



NOTE:

For abbreviation of wire color, refer to "Abbreviations and Symbols May be Used in This Manual" in Section 0A.

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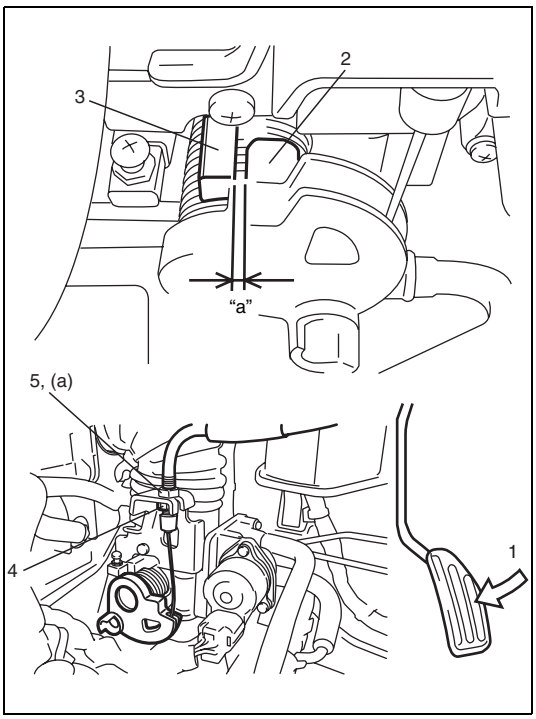
On-Vehicle Service

Accelerator cable adjustment



With accelerator pedal depressed fully (1), check clearance between throttle lever (2) and lever stopper (3) (throttle body) which should be within following specification.
If measured value is out of specification, adjust it to specification with cable adjusting nut (4).
Tighten lock nut (5) to specified torque

Accelerator cable adjustment clearance (with pedal depressed fully)
"a": 0.5 – 2.0 mm (0.02 – 0.07 in.)

Tightening torque
Accelerator cable lock nut
(a): 12 N·m (1.2 kg-m, 9.0 lb-ft)

Idle speed/idle air control (IAC) duty inspection

Before idle speed/IAC duty check, make sure of the following.

- Lead wires and hoses of Electronic Fuel Injection and engine emission control systems are connected securely.
- Accelerator cable has some play, that is, it is not tight.
- Valve lash is checked and adjusted according to maintenance schedule.
- Ignition timing is within specification.
- All accessories (wipers, heater, lights, A/C, etc.) are out of service.
- Air cleaner has been properly installed and is in good condition.
- No abnormal air inhaling from air intake system.

After above items are all confirmed, check idle speed and IAC duty as follows.

NOTE:

Before starting engine, place transmission gear shift lever in "Neutral" and set parking brake and block drive wheels.

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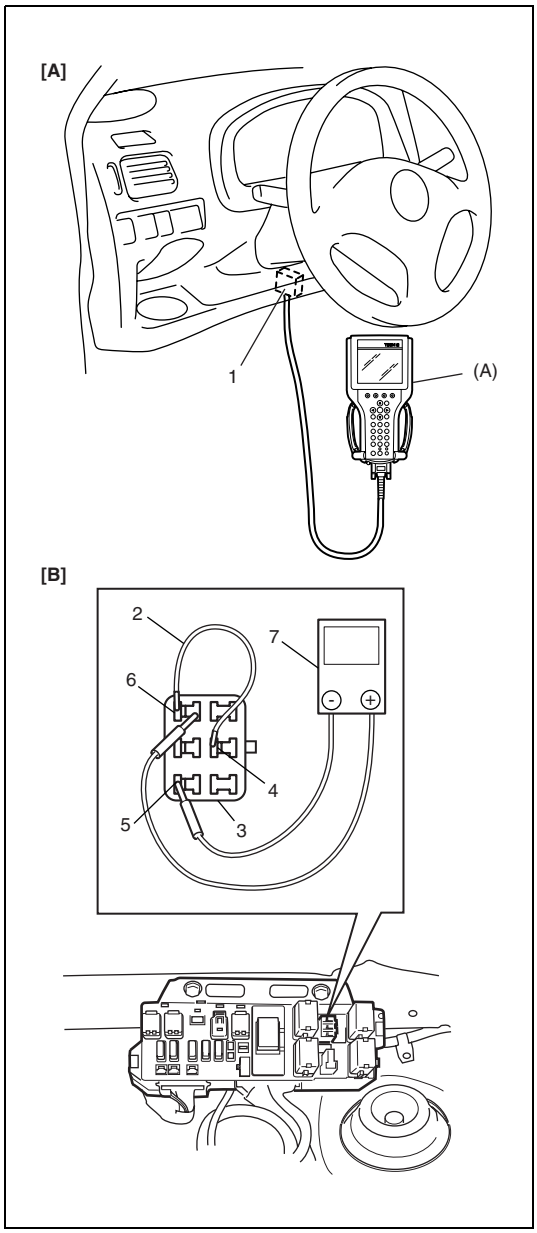


1) Connect scan tool (1) to DLC with ignition switch OFF, if it is available.

Special tool
(A): SUZUKI scan tool

2) Warm up engine to normal operating temperature.
3) Check engine idle speed and "IAC duty" as follows:
   a) When using scan tool:
      i) Select "Data List" mode on scan tool to check "IAC duty".

[A]:	When using scan tool
[B]:	When using duty meter (Vehiche without immobilizer indicator lamp)

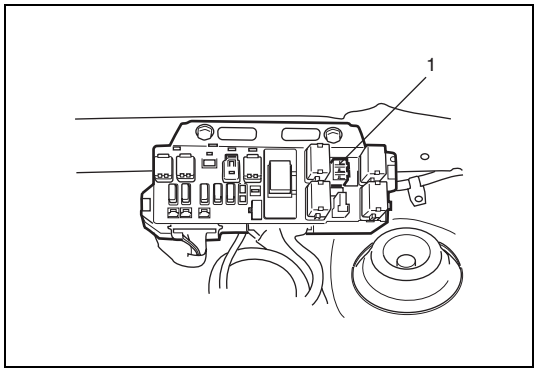
   b) When using duty meter (7):
      i) Set tachometer.
      ii) Using service wire (2), ground "Diag. switch terminal" (4) in monitor connector (3) and connect duty meter between "Duty output terminal" (5) and "Ground terminal" (6) of monitor connector (3).
4) If duty and/or idle speed is out of specifications, inspect idle air control system referring to "Diagnostic Flow Table B-4 Idle Air Control System Check" in Section 6-1.

Engine idle speed and IAC duty

A/C OFF	A/C ON
700 ± 50 r/min (rpm) **5 – 25 %**	**850 ± 50 r/min (rpm)**

NOTE:

Above duty value is ON duty (low voltage rate) meter indications.



5) Remove service wire from monitor connector (1).
6) Check that specified engine idle speed is obtained with A/C ON if vehicle is equipped with A/C.
   If not, check A/C ON signal circuit and idle air control system.

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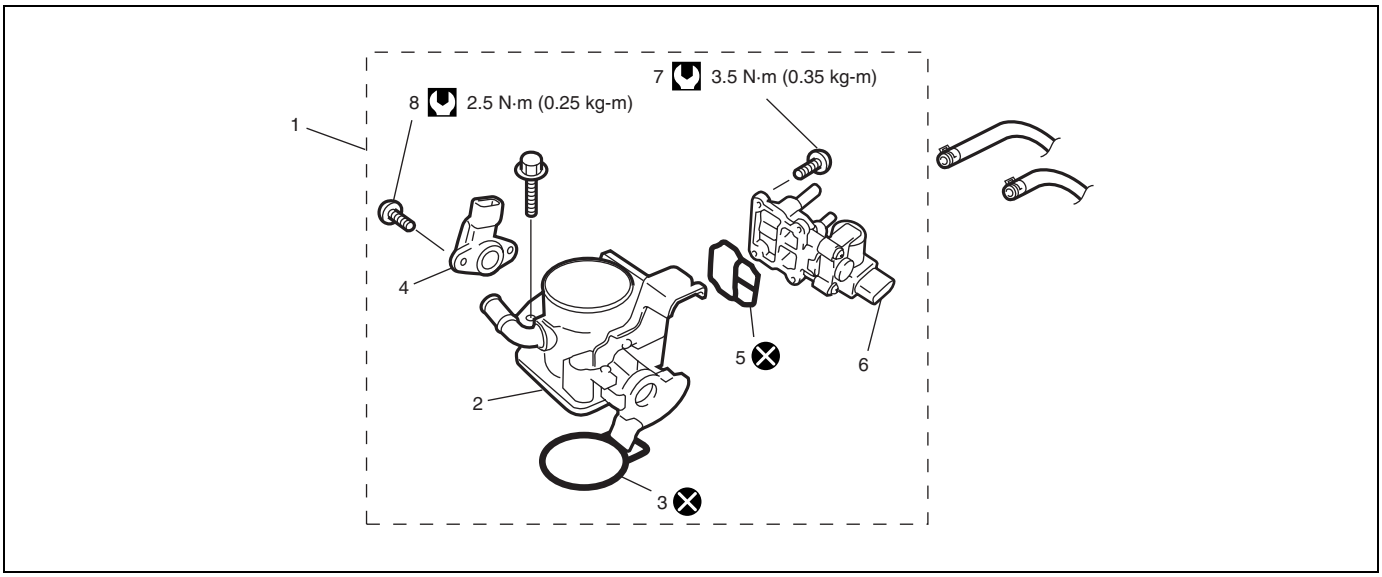
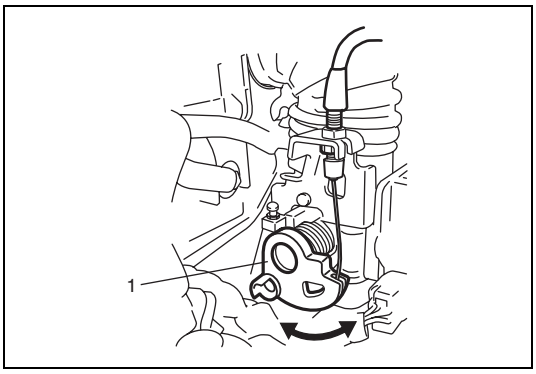
Air Intake System

Throttle body components



1. Throttle body assembly	4. TP sensor	7. IAC valve screws	Do not reuse.
2. Throttle body	5. Gasket	8. TP sensor screws	
3. Throttle body gasket	6. Idle air control valve	Tightening torque	

Throttle body on-vehicle inspection

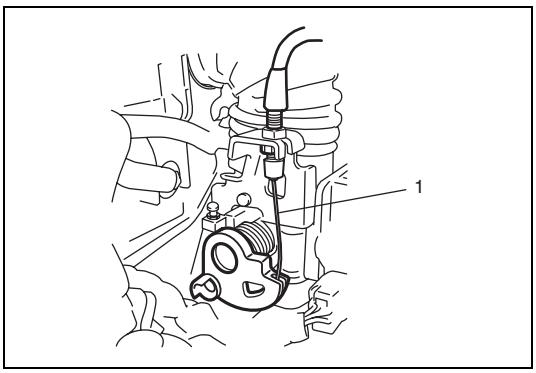


- Check that throttle valve lever (1) moves smoothly.

Throttle body removal and installation

Removal

1) Disconnect negative cable at battery.
2) Drain coolant referring to “Cooling System Draining” in Section 6B.
3) Detach EVAP canister from its bracket.



4) Disconnect accelerator cable (1) from throttle valve lever.

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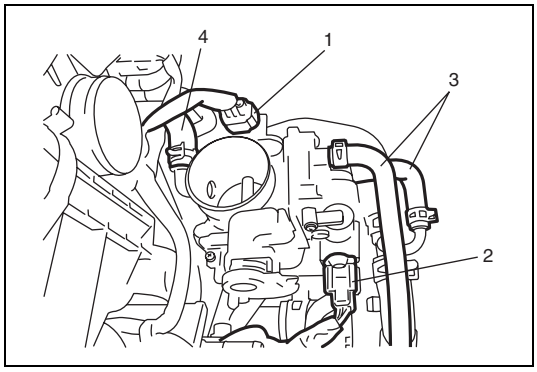
5) Disconnect IAT sensor connector and remove air cleaner outlet hose.



6) Disconnect electric connector from TP sensor (1) and IAC valve (2).
7) Disconnect engine coolant hoses (3) and breather hose (4) from throttle body.

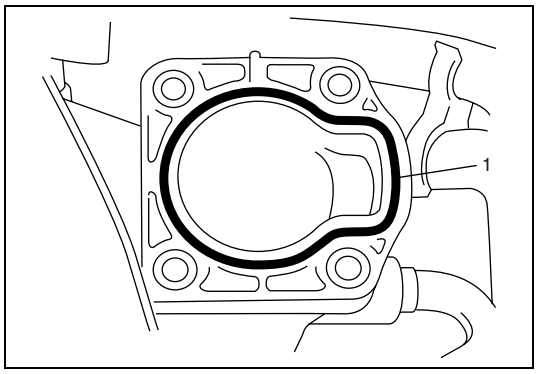
8) Remove throttle body from intake manifold.
9) Remove TP sensor and IAC valve from throttle body.

NOTE:

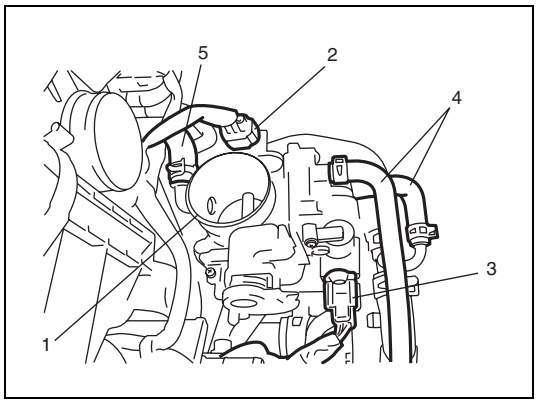
While disassembling and assembling throttle body, use special care not to deform levers on throttle valve shaft or cause damage to any other parts.

Installation

1) Install IAC valve to throttle body referring to “Installation” under “Idle Air Control Valve (IAC Valve) Removal and Installation” in this section.
2) Install TP sensor to throttle body referring to “installation” under “Throttle Position Sensor (TP Sensor) Removal and Installation” in this section.



3) Clean mating surfaces and install new throttle body gasket (1) to intake manifold.



4) Install throttle body (1) to intake manifold.
5) Connect connectors to TP sensor (2) and IAC valve (3) securely.
6) Connect engine coolant hoses (4) and breather hose (5).

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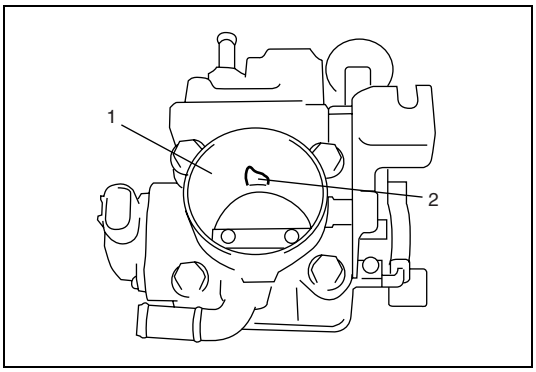
7) Connect accelerator cable and adjust cable play to specification.
8) Install air cleaner outlet hose and connect IAT sensor connector.
9) Install EVAP canister to its bracket.
10) Refill coolant referring to “Cooling System Refill” in Section 6B.
11) Connect negative cable at battery.

Throttle body cleaning



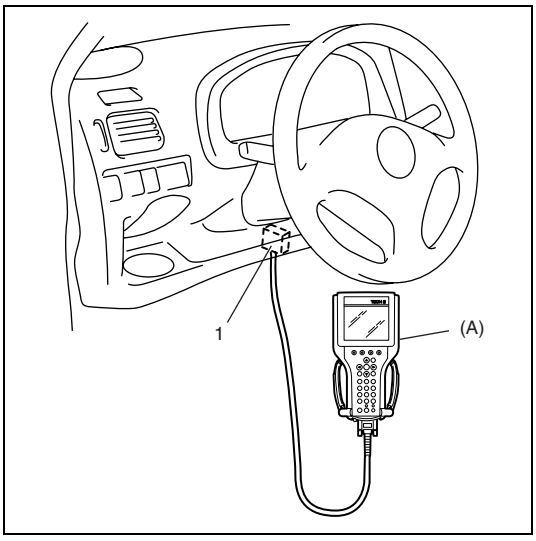
Clean throttle body bore (1) and idle air passage (2) by blowing compressed air.

NOTE:

TP sensor, idle air control valve or other components containing rubber must not be placed in a solvent or cleaner bath. A chemical reaction will cause these parts to swell, harden or get distorted.

Idle air control valve (IAC valve) operation check

Using SUZUKI Scan Tool



1) Connect SUZUKI scan tool to DLC (1) with ignition switch OFF.

Special tool
(A): SUZUKI scan tool

2) Warm up engine to normal operating temperature.
3) Clear DTC and select “MISC TEST” mode on SUZUKI scan tool.
4) Check that idle speed increases and/or reduces when IAC valve is opened and/or closed by SUZUKI scan tool.
   If idle speed does not change, check IAC valve and wire harness.

Not Using SUZUKI Scan Tool

1) Warm up engine to normal operating temperature.
2) Stop engine.
3) Turn ignition switch to ON position.
4) Disconnect IAC valve connector.
5) Start engine.
6) Connect IAC valve connector.
7) Check that idle speed increases and/or reduces when connector is connected to IAC valve.
   If idle speed does not change, check IAC valve and wire harness.

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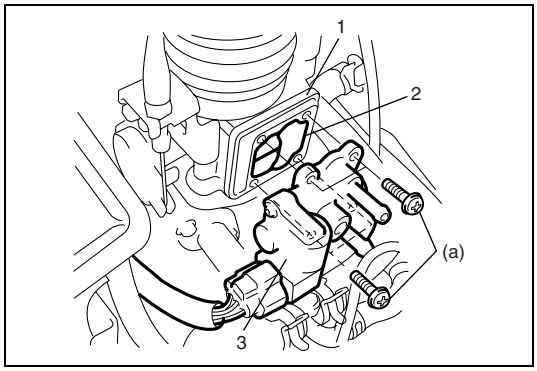
Idle air control valve (IAC valve) removal and installation

Removal

1) Detach EVAP canister.
2) Drain coolant referring to “Cooling System Draining” in Section 6B.
3) Disconnect coolant hoses from IAC valve.
4) Remove IAC valve from throttle body.

Installation

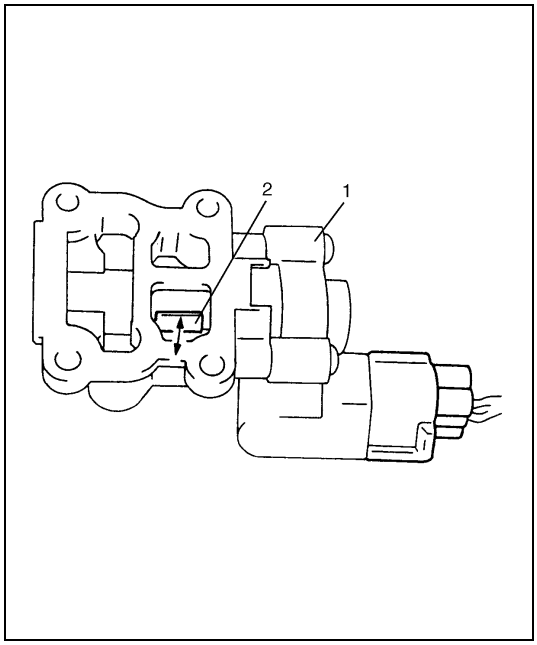


1) Install new gasket (2) to throttle body (1).
2) Install IAC valve (3) to throttle body (1).
   Tighten IAC valve screws to specified torque.

Tightening torque
IAC valve screw (a): 3.5 N·m (0.35 kg-m, 2.5 lb-ft)

3) Connect coolant hoses to IAC valve.
4) Refill coolant referring to “Cooling System Refill” in Section 6B.
5) Install EVAP canister.

Idle air control valve (IAC valve) inspection



1) Connect each connector to IAC valve (1), TP sensor and IAT sensor.
2) Check that rotary valve (2) of IAC valve opens and closes once and then stops in about 60 ms as soon as ignition switch is turned ON.

NOTE:

- **This check should be performed by two people, one person turns on ignition switch while the other checks valve operation.**
- **As valve operation is momentary, it may be overlooked. To prevent this, perform this operation check 3 times or more continuously.**
  If rotary valve of IAC valve does not operate at all, check wire harness for open and short. If wire harness is in good condition, replace IAC valve and recheck.

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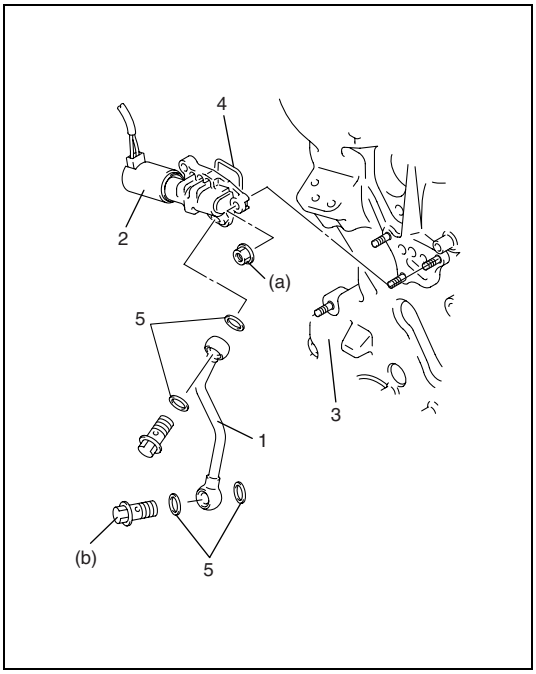
Oil control valve removal and installation

Removal



Remove oil gallery pipe No.1 (1) and oil control valve (2) from timing chain cover (3).

Installation

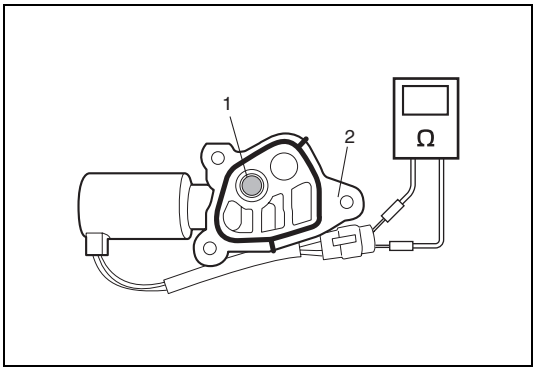
1) Install new O-ring (4) to oil control valve.
2) Install oil control valve to timing chain cover.
   Tighten nuts to specification.

Tightening torque
Oil control valve mounting nuts
(a): 11 N·m (1.1 kg-m, 8.0 lb-ft)

3) Install oil gallery pipe No.1 with new copper washers (5) to timing chain cover.
   Tighten bolts to specification.

Tightening torque
Oil gallery pipe No.1 bolts
(b): 30 N·m (3.0 kg-m, 21.5 lb-ft)

Oil control valve inspection



1) Inspect strainer (1) and mating surface (2) of oil control valve for clog or damage. Clean oil control valve if clog or foreign matter is present on strainer or mating surface of oil control valve.
   Replace oil control valve if its mating surface is damaged.
2) Check resistance between terminals of oil control valve.

Resistance of oil control valve
6.7 – 7.7 Ω (at 20°C (68°F))

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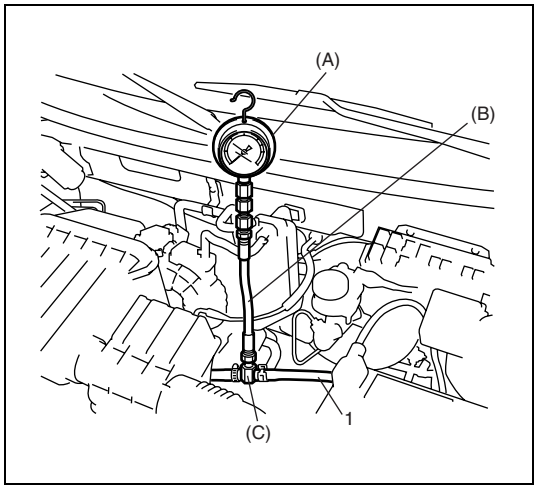
Fuel Delivery System

Fuel pressure inspection

WARNING:
Be sure to perform work in a well-ventilated area and away from any open flames, or there is a risk of a fire breaking out.

1) Relieve fuel pressure in fuel feed line referring to "Fuel Pressure Relief Procedure" in Section 6-1.
2) Disconnect fuel feed hose from fuel delivery pipe.

CAUTION:
A small amount of fuel may be released when fuel hose is disconnected. Place container under the joint with a shop cloth so that released fuel is caught in container or absorbed in cloth. Place that cloth in an approved container.



3) Connect special tools and hose between fuel delivery pipe and fuel feed hose (1) as shown in figure, and clamp hoses securely to ensure no leaks occur during checking.

Special tool
(A): 09912-58442
(B): 09912-58432
(C): 09912-58490

4) Check that battery voltage is above 11 V.
5) Turn ignition switch ON to operate fuel pump and after 2 seconds turn it OFF. Repeat this 3 or 4 times and then check fuel pressure.

Fuel pressure specification

CONDITION	FUEL PRESSURE
With fuel pump operating and engine stopped	270 – 310 kPa (2.7 – 3.1 kg/cm^2, 38.4 – 44.0 psi)
At specified idle speed	
Within 1 min. after engine (fuel pump) stop (Pressure reduces as time passes)	over 250 kPa (2.5 kg/cm^2, 35.6 psi)

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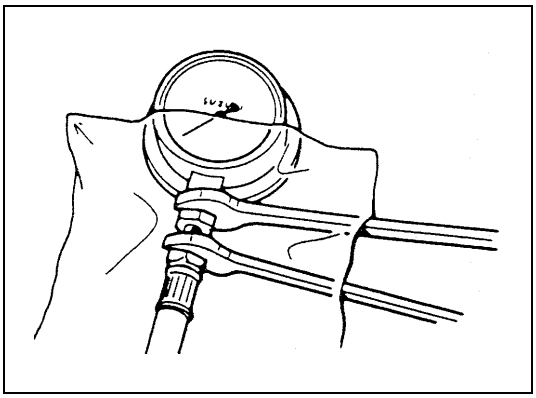
6) Start engine and warm it up to normal operating temperature.
7) Measure fuel pressure at idling.
   If measured pressure does not satisfy specification, refer to "Diagnostic Flow Table B-3" in Section 6-1 and check each possibly defective part. Replace if found defective.



8) After checking fuel pressure, remove fuel pressure gauge.

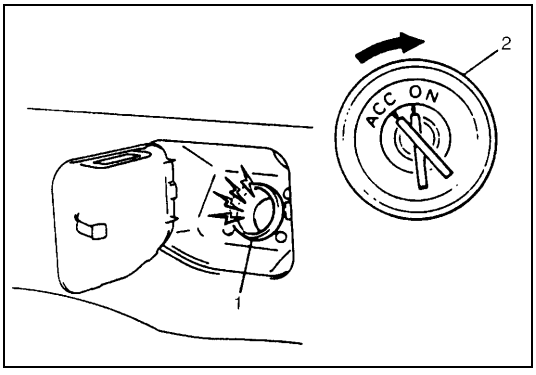
CAUTION:
As fuel feed line is still under high fuel pressure, make sure to release fuel pressure according to following procedures.
- **Place fuel container under joint.**
- **Cover joint with rag and loosen joint nut slowly to release fuel pressure gradually.**

9) Remove special tools from fuel delivery pipe and fuel feed hose.
10) Connect fuel feed hose to fuel delivery pipe and clamp it securely.
11) With engine "OFF" and ignition switch "ON", check for fuel leaks.

Fuel pump with pressure regulator on-vehicle inspection

CAUTION:
When fuel filler cap is removed in any procedure, work must be done in a well-ventilated area, keep away from any open flames and without smoking.

NOTE:
The fuel pressure regulator is the one body with the fuel pump assembly so individual inspection of it is impossible.



1) Remove filler cap and turn ON ignition switch. Then fuel pump operating sound should be heard from fuel filler for about 2 seconds and stop. Be sure to reinstall fuel filler cap after checking.
   If above check result is not satisfactory, advance to "Diagnostic Flow Table B-2" in Section 6-1.

1.	Fuel filler
2.	Ignition switch

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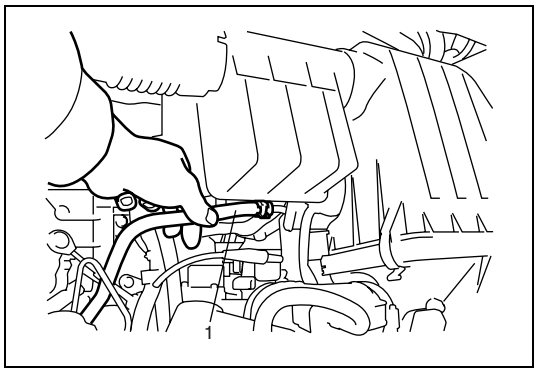


2) Turn OFF ignition switch and leave over 10 minutes as it is.
3) Fuel pressure should be felt at fuel feed hose (1) for about 2 seconds after ignition switch ON.
   If fuel pressure is not felt, advance to “Diagnostic Flow Table B-3” in Section 6-1.

Fuel pump with pressure regulator removal and installation

Removal

Remove fuel tank from body according to procedure described in “Fuel Tank” of Section 6C and remove fuel pump from fuel tank.

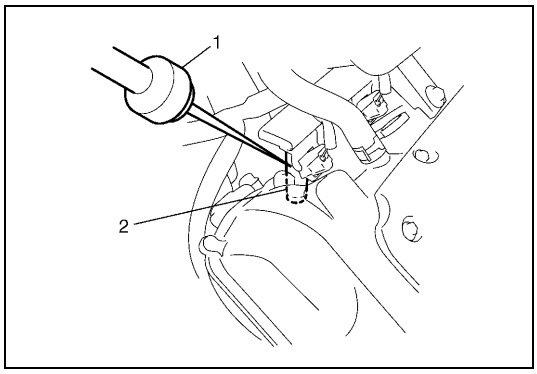
Installation

1) Install fuel pump to its bracket.
2) Install fuel pump to fuel tank and then install fuel tank to body according to procedure described in “Fuel Tank” of Section 6C.

Fuel pump with pressure regulator inspection

Check fuel pump filter for evidence of dirt and contamination. If present, clean and check for presence of dirt in fuel tank.

Fuel injector on-vehicle inspection



1) Using sound scope (1) or such, check operating sound of injector (2) when engine is running or cranking.
   Cycle of operating sound should vary according to engine speed.
   If no sound or an unusual sound is heard, check injector circuit (wire or connector) or injector (2).

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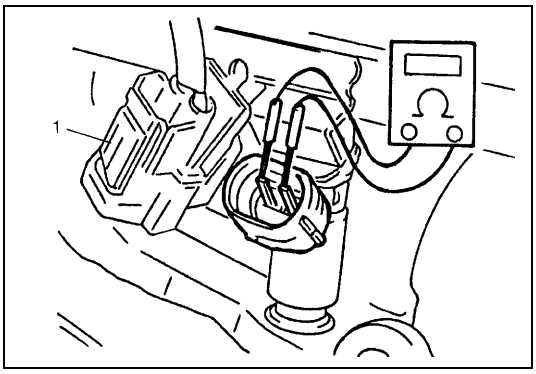


2) Disconnect connector (1) from injector, connect ohmmeter between terminals of injector and check resistance.
   If resistance is out of specification, replace.

   Resistance of fuel injector
   11.3 – 13.8 Ω at 20°C (68°F)

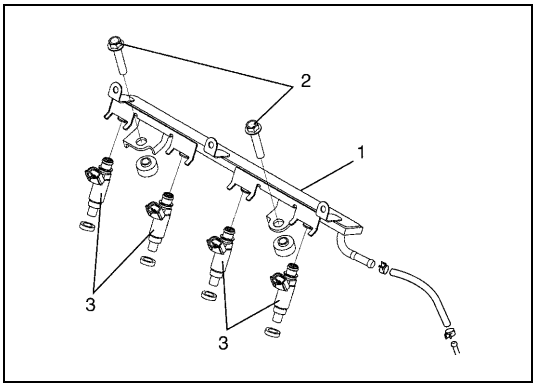
3) Connect connector (1) to injector securely.

Fuel injector removal and installation

Removal

CAUTION:
A small amount of fuel may come out after removal of fuel injectors, cover them with shop cloth.

1) Relieve fuel pressure according to procedure described in "Fuel Pressure Relief Procedure" of Section 6-1.
2) Disconnect battery negative cable at battery.
3) Remove air cleaner assembly and resonator.
4) Disconnect fuel injector couplers.



5) Disconnect fuel feed hose from fuel delivery pipe (1).
6) Remove fuel delivery pipe bolts (2).
7) Remove fuel injector(s) (3).

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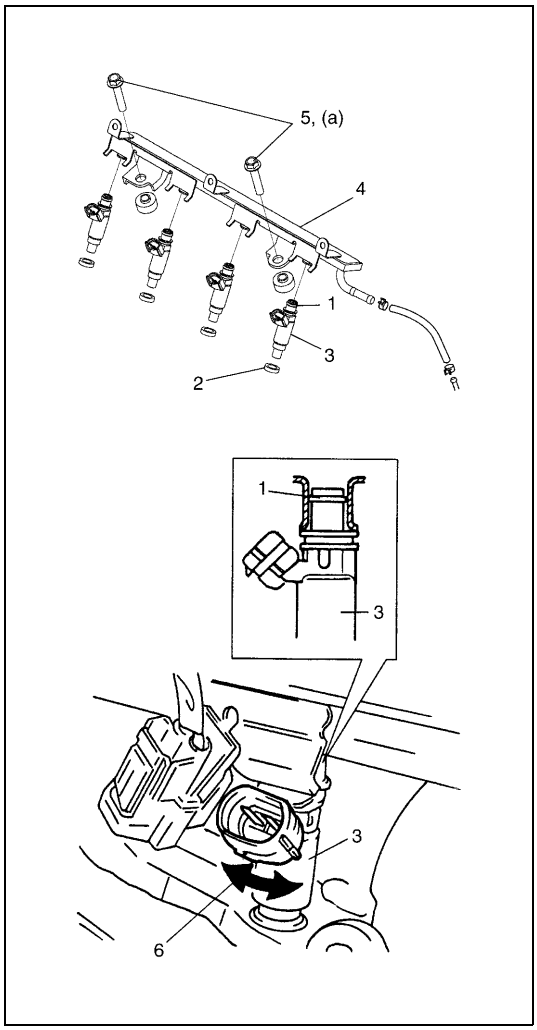

Installation

For installation, reverse removal procedure and note following precautions.

- Replace injector O-ring (1) with new one using care not to damage it.
- Check if cushion (2) is scored or damaged. If it is, replace with new one.
- Apply thin coat of fuel to O-rings (1) and then install injectors (3) into delivery pipe (4) and cylinder head.
  Make sure that injectors (3) rotate smoothly (6). If not, probable cause is incorrect installation of O-ring (1). Replace O-ring (1) with new one.
- Tighten delivery pipe bolts (5) and make sure that injectors (3) rotate smoothly (6).

Tightening torque
Delivery pipe bolts (a): 25 N·m (2.5 kg-m, 18.0 lb-ft)

- After installation, with engine “OFF” and ignition switch “ON”, check for fuel leaks around fuel line connection.

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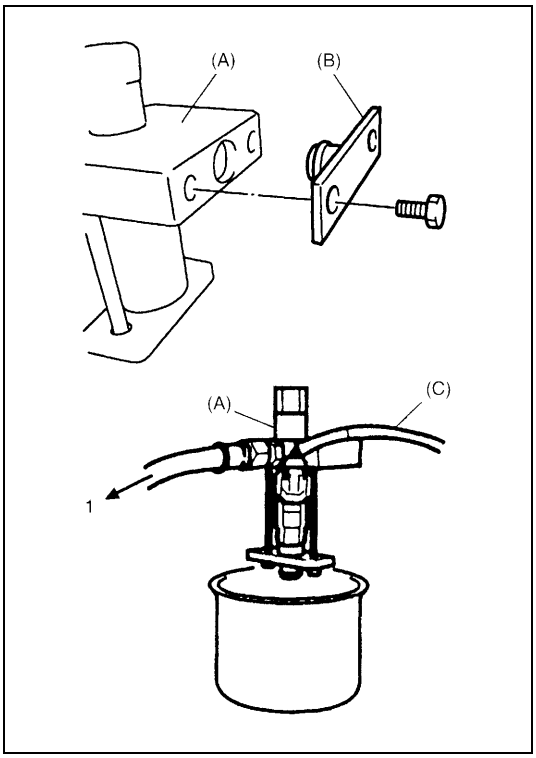
Fuel injector inspection

WARNING:
As fuel is injected in this inspection, perform in a well ventilated area and away from open flames.
Use special care to prevent sparking when connecting and disconnecting test lead to and from battery.



1) Install injector to special tool (injector checking tool).

Special tool
(A): 09912-58421
(B): 09912-57610

2) Connect special tools (hose and attachment) to fuel feed pipe (1) of vehicle.
3) Connect special tool (test lead) to injector.

Special tool
(C): 09930-88530

4) Install suitable vinyl tube onto injector nozzle to prevent fuel from splashing out when injecting.
5) Put graduated cylinder under injector as shown.

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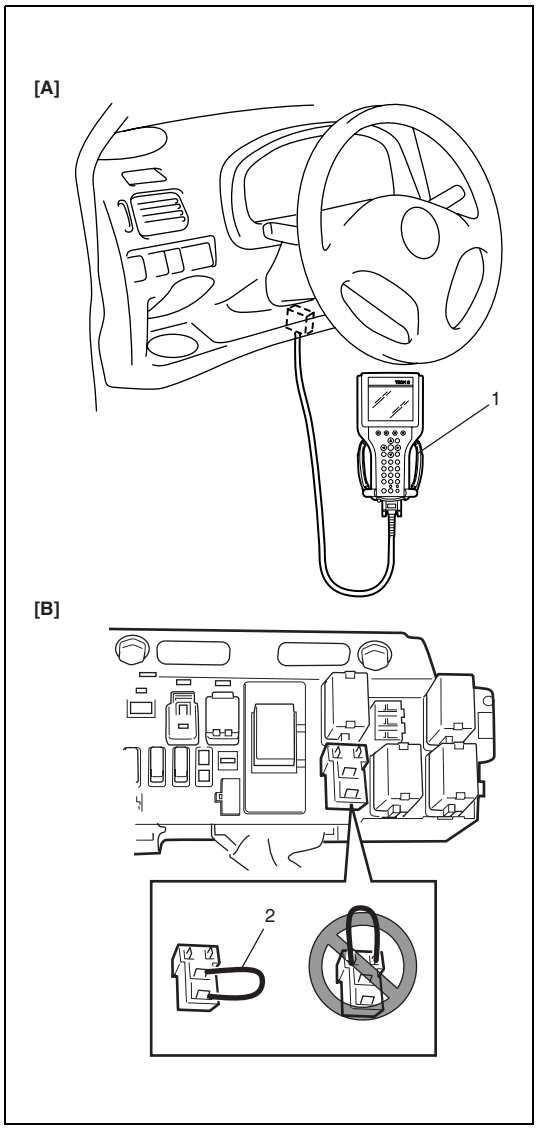
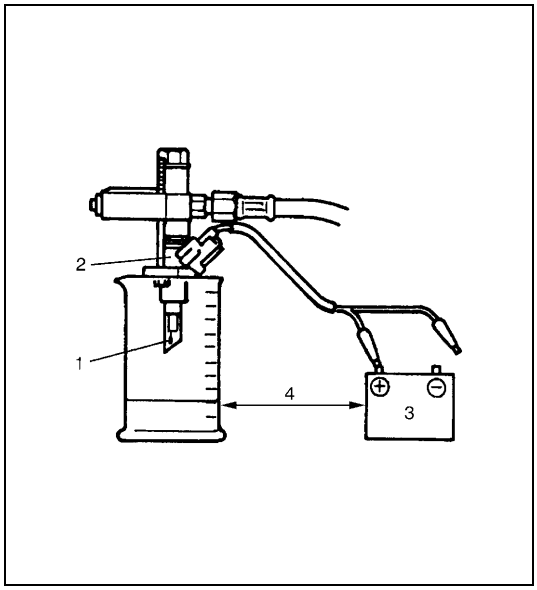


6) Operate fuel pump and apply fuel pressure to injector as follows:
   a) When using scan tool:
      i) Connect scan tool (1) to DLC with ignition switch OFF.
      ii) Turn ignition switch ON, clear DTC and select “MISC TEST” mode on scan tool.
      iii) Turn fuel pump ON by using scan tool.
   b) Without using scan tool:
      i) Remove fuel pump relay from connector.
      ii) Connect two terminals of relay connector using service wire (2) as shown in figure.

CAUTION:
Check to make sure that connection is made between correct terminals. Wrong connection can cause damage to ECM, wire harness, etc.

      iii) Turn ignition switch ON.

[A]: When using SUZUKI scan tool
[B]: When not using SUZUKI scan tool



7) Apply battery voltage (3) to injector (2) for 15 seconds and measure injected fuel volume with graduated cylinder.
   Test each injector two or three times.
   If not within specification, replace injector.

Injected fuel volume
48 – 51 cc/15 sec. (1.62/1.69 – 1.72/ 1.80 US/Imp. oz/15 sec.)

8) Check fuel leakage from injector nozzle. Do not operate injector for this check (but fuel pump should be at work).
   If fuel leaks (1) more than following specifications, replace.

Fuel leakage
Less than 1 drop/min.

4. Keep as far apart as possible

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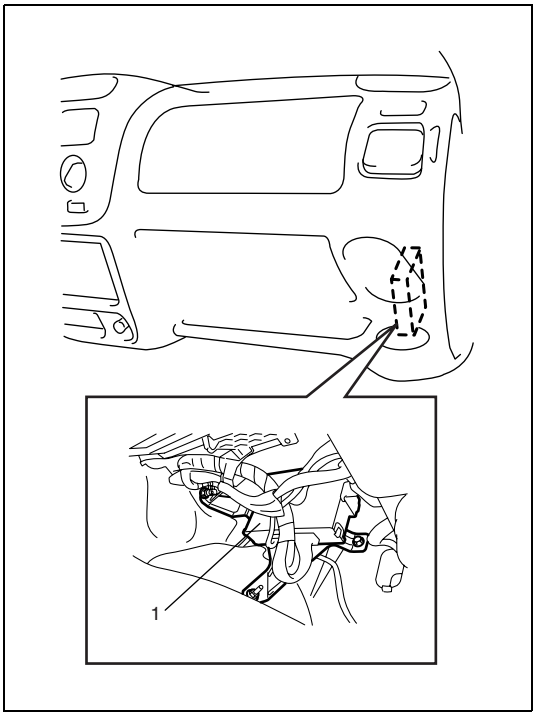
Electronic Control System

Engine control module (ECM) removal and installation

CAUTION:
As ECM consists of precision parts, be careful not to expose it to excessive shock.

Removal

1) Disconnect battery negative cable at battery.
2) Disable air bag system, referring to “Disabling Air Bag System” in Section 10B.
3) Disconnect ECM (1) connectors.
4) Remove bolt and nuts, remove ECM.



Installation

Reverse removal procedure noting the following:

- Connect connectors to ECM securely.

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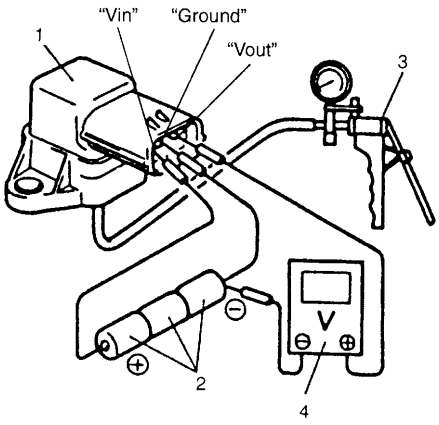
Manifold absolute pressure sensor (MAP sensor) inspection



1) Disconnect connector from MAP sensor (1).
2) Remove MAP sensor (1).
3) Arrange 3 new 1.5 V batteries (2) in series (check that total voltage is 4.5 – 5.0 V) and connect its positive terminal to "Vin" terminal of sensor and negative terminal to "Ground" terminal. Then check voltage between "Vout" and "Ground". Also, check if voltage reduces when vacuum is applied up to 400 mmHg by using vacuum pump (3).

Output voltage (When input voltage is 4.5 – 5.5 V, ambient temp. 20 – 30°C, 68 – 86°F)

ALTITUDE (Reference)		BAROMETRIC PRESSURE		OUTPUT VOLTAGE
(ft)	(m)	(mmHg)	(kPa)	(V)
0 | 2 000	0 | 610	760 | 707	100 | 94	3.3 – 4.3
2 001 | 5 000	611 | 1 524	Under 707 over 634	94 | 85	3.0 – 4.1
5 001 | 8 000	1 525 | 2 438	Under 634 over 567	85 | 76	2.7 – 3.7
8 001 | 10 000	2 439 | 3 048	Under 567 over 526	76 | 70	2.5 – 3.3

If check result is not satisfactory, replace MAP sensor (1).

4) Install MAP sensor (1) securely.
5) Connect MAP sensor (1) connector securely.

4. Digital type voltmeter

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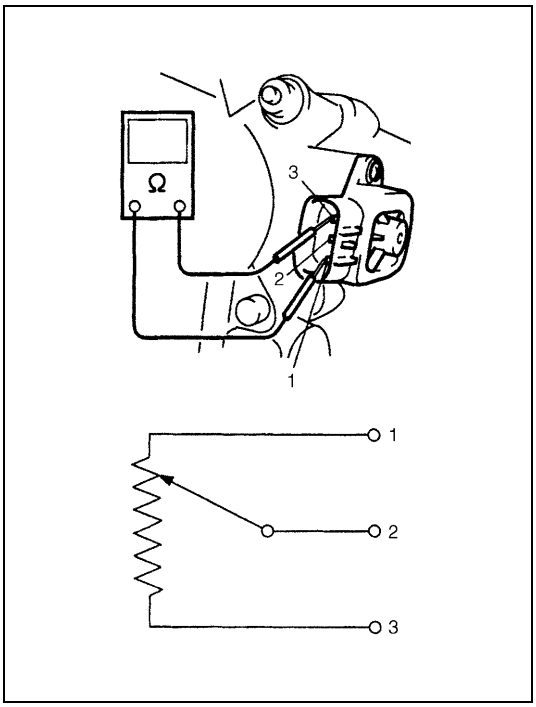
Throttle position sensor (TP sensor) on-vehicle inspection

1) Disconnect negative cable at battery and connector from IAT sensor.
2) Detach EVAP canister and remove air cleaner outlet hose.
3) Disconnect TP sensor connector.



4) Using ohmmeter, check resistance between terminals under each condition given in table below.
   If check result is not satisfactory, replace TP sensor.

TP sensor resistance

TERMINALS	RESISTANCE
Between 1 and 3 terminals	4.0 – 6.0 kΩ
Between 2 and 3 terminals	20 Ω – 6.0 kΩ, varying according to throttle valve opening.

NOTE:

There should be more than 2 kΩ resistance difference between when throttle valve is at idle position and when it is fully open.

1. Reference voltage terminal
2. Output voltage terminal
3. Ground terminal

5) Connect TP sensor connector securely.
6) Install air cleaner outlet hose and EVAP canister.
7) Connect IAT sensor connector to IAT sensor and negative cable to battery.

Throttle position sensor (TP sensor) removal and installation

Removal

1) Disconnect battery negative cable at battery.
2) Detach EVAP canister and remove air cleaner outlet hose.
3) Disconnect TP sensor connector.
4) Remove TP sensor from throttle body.

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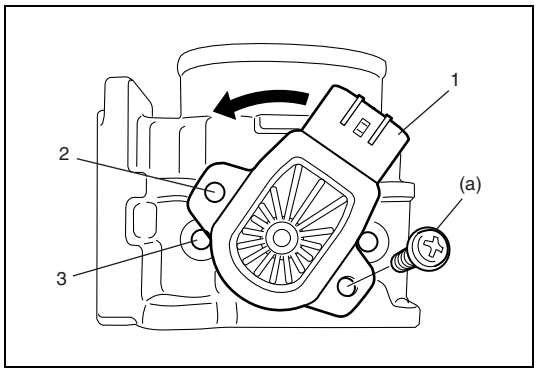
Installation



1) Install TP sensor (1) to throttle body.
   Fit TP sensor to throttle body in such way that its holes (3) are a little away from TP sensor screw holes (2) as shown in figure and turn TP sensor counterclockwise so that those holes align.

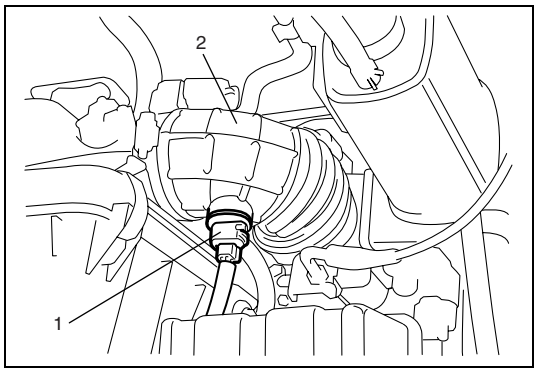
Tightening torque
TP sensor screw (a): 2.5 N·m (0.25 kg-m, 1.8 lb-ft)

2) Connect connector to TP sensor securely.
3) Install air cleaner outlet hose and EVAP canister.
4) Connect battery negative cable to battery.

Intake air temperature sensor (IAT sensor) removal and installation

Removal

1) Disconnect battery negative cable at battery.

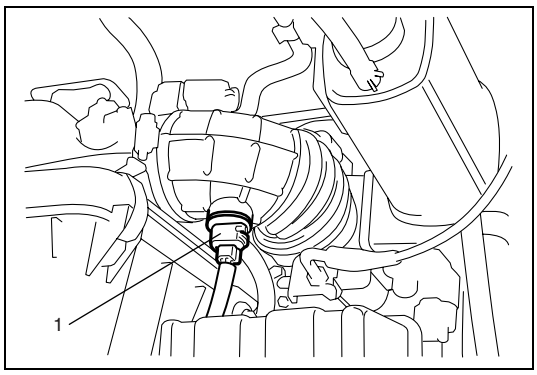


2) Disconnect coupler (1) from IAT sensor.
3) Remove IAT sensor from air cleaner outlet hose (2).

Installation

Reverse removal procedure noting the following.

- Clean mating surfaces of IAT sensor and air cleaner outlet hose.



- Connect IAT sensor connector (1) securely.

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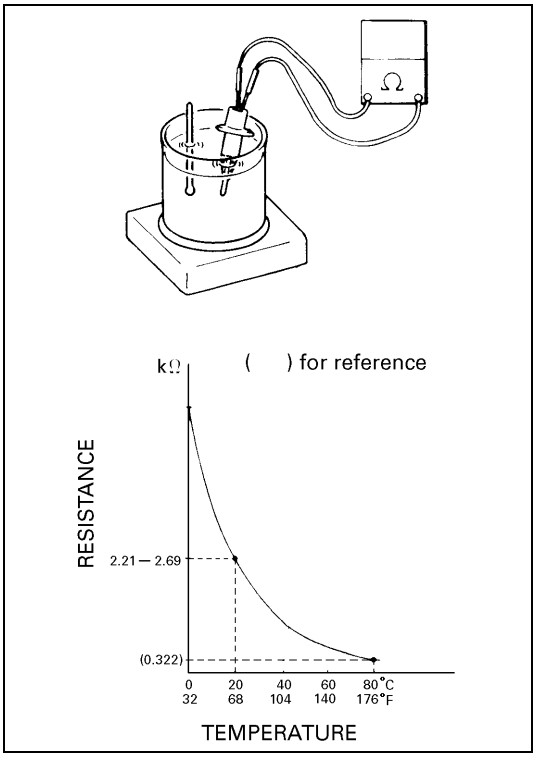
Intake air temperature sensor (IAT sensor) inspection



Immerse temperature sensing part of IAT sensor in water (or ice) and measure resistance between sensor terminals while heating water gradually.
If measured resistance does not show such characteristic as shown in the graph, replace IAT sensor.

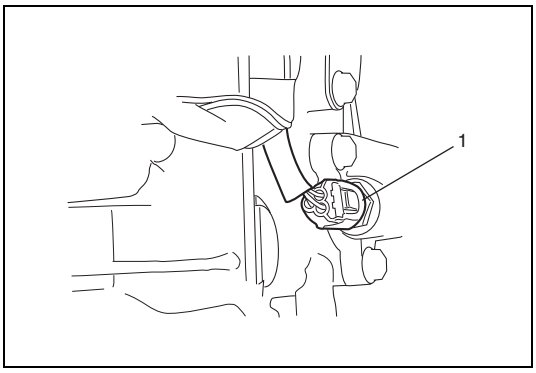
Engine coolant temperature sensor (ECT sensor) removal and installation

Removal

1) Disconnect battery negative cable at battery.
2) Drain coolant referring to “Cooling System Draining” in Section 6B.

WARNING:
To help avoid danger of being burned, do not remove radiator cap while engine and radiator are still hot.
Scalding fluid and steam can be blown out under pressure if cap is taken off too soon.

3) Remove air intake pipe.
4) Disconnect connector from ECT sensor.
5) Remove ECT sensor (1) from water outlet cap.



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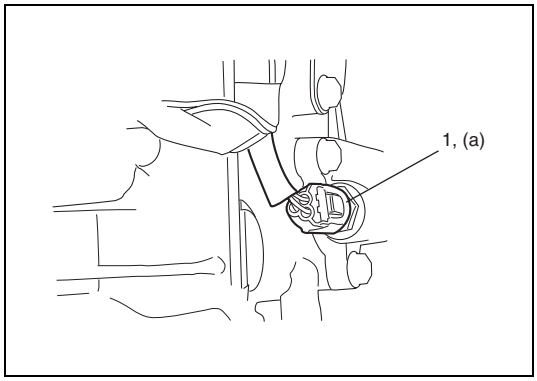


Installation

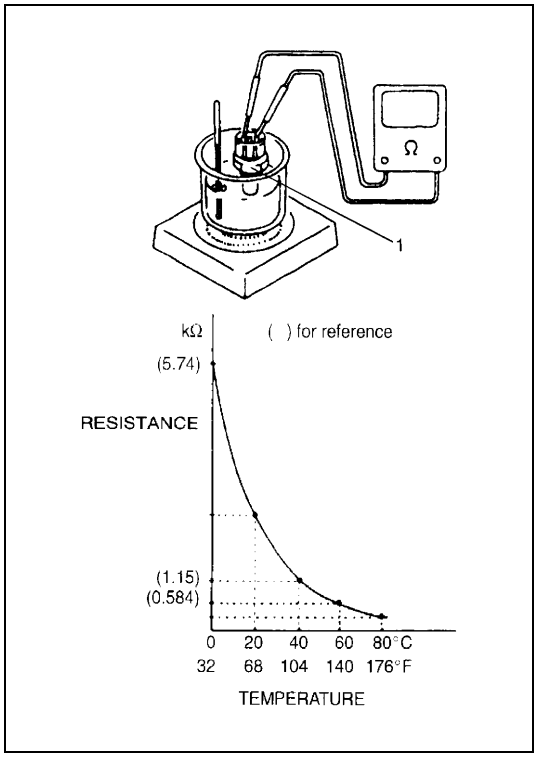
Reverse removal procedure noting the following:

- Clean mating surfaces of ECT sensor (1) and water outlet pipe.
- Check O-ring for damage and replace if necessary.
- Tighten ECT sensor (1) to specified torque.

Tightening torque
ECT sensor (a): 15 N·m (1.5 kg-m, 11.5 lb-ft)

- Connect connector to ECT sensor (1) securely.
- Refill coolant referring to “Cooling System Refill” in Section 6B.

Engine coolant temperature sensor (ECT sensor) inspection



Immerse temperature sensing part of ECT sensor (1) in water (or ice) and measure resistance between terminals while heating water gradually.
If measured resistance does not show such characteristic as shown in the graph, replace ECT sensor (1).

Heated oxygen sensor (HO2S-1 and HO2S-2) heater on-vehicle inspection

1) Disconnect sensor connector.

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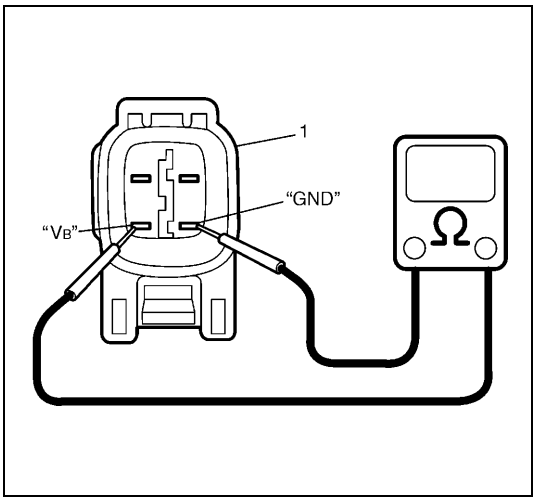


2) Using ohmmeter, measure resistance between terminals "V_B" and "GND" of sensor connector.
   If found faulty, replace oxygen sensor.

NOTE:

Resistance value of sensor heater is affected temperature of sensor largely.
Make sure that sensor heater is at correct temperature.

Resistance of oxygen sensor heater
HO2S–1: 5.0 – 6.4 Ω at 20°C (68°F)
HO2S–2: 11.7 – 14.3 Ω at 20°C (68°F)

1. Viewed from terminal side

3) Connect sensor connector securely.

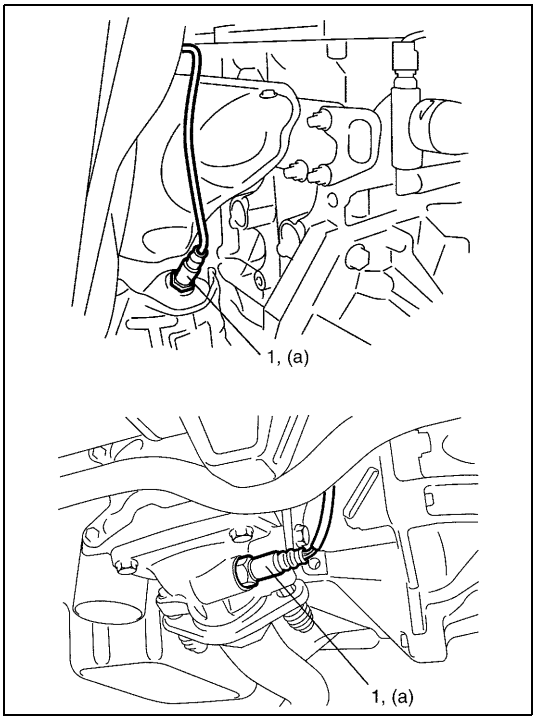
Heated oxygen sensor (HO2S-1 and HO2S-2) removal and installation

Removal

WARNING:

To avoid danger of being burned, do not touch exhaust system when system is hot. Oxygen sensor removal should be performed when system is cool.

1) Disconnect negative cable at battery.
2) For HO2S–1, disconnect connector of heated oxygen sensor and release its wire harness from clamps, then remove exhaust manifold stiffener referring to "Exhaust Manifold Components" in Section 6A2.
3) For HO2S–2, disconnect connector of heated oxygen sensor and release its wire harness from clamp and hoist vehicle.
4) Remove heated oxygen sensor (1) from exhaust manifold or exhaust pipe.



Installation

Reverse removal procedure noting the following.

- Tighten heated oxygen sensor (1) to specified torque.

Tightening torque
Heated oxygen sensor (a): 45 N·m (4.5 kg-m, 32.5 lb-ft)

- Install exhaust manifold stiffener referring to "Exhaust Manifold Components" in Section 6A2.
- Connect connector of heated oxygen sensor (1) and clamp wire harness securely.
- After installing heated oxygen sensor (1), start engine and check that no exhaust gas leakage exists.

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Camshaft position sensor (CMP sensor) inspection

1) Confirm that terminal voltages and ground circuit continuity at CMP sensor connector terminals are in good condition referring to Step 3 and 5 of “DTC P0340 Diag. Flow” in Section 6-1.
   If not, repair CMP sensor circuit.
2) Check that CMP sensor signal voltage varies from low to high or from high to low as specified referring to Step 6 of “DTC P0340 Diag. Flow” in Section 6-1.
   If signal voltage varies as specified, CMP sensor is in good condition.
   If not, replace CMP sensor.

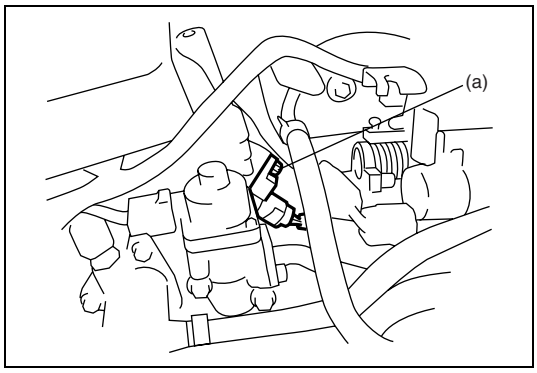
Camshaft position sensor (CMP sensor) removal and installation

Removal

1) Disconnect negative cable at battery.
2) Disconnect connector from camshaft position sensor.
3) Remove camshaft position sensor from cylinder head.

Installation

1) Check that O-ring is free from damage.
2) Check that camshaft position sensor and signal rotor teeth are free from any metal particles and damage.



3) Install camshaft position sensor to timing chain cover.

Tightening torque
Camshaft position sensor bolt
(a): 10 N·m (1.0 kg-m, 7.5 lb-ft)

4) Connect connector to it securely.
5) Connect negative cable to battery.

Crankshaft position sensor (CKP sensor) inspection

1) Confirm that terminal voltages and ground circuit continuity at CKP sensor connector terminals are in good condition referring to Step 3 and 5 of “DTC P0335 Diag. Flow” in Section 6-1.
   If not, repair CKP sensor circuit.
2) Check that CKP sensor signal voltage varies from low to high or from high to low as specified referring to Step 7 of “DTC P0335 Diag. Flow” in Section 6-1.
   If signal voltage varies as specified, CKP sensor is in good condition.
   If not, replace CKP sensor.

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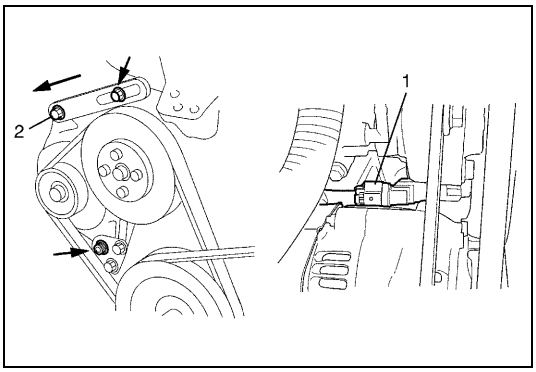
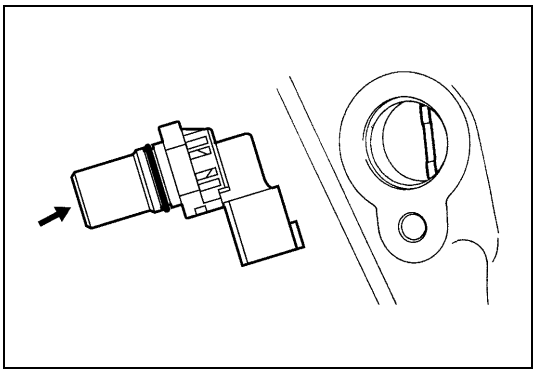
Crankshaft position sensor (CKP sensor) removal and installation

Removal



1) Disconnect negative cable at battery.
2) Remove generator drive belt, loosen pivot bolt (2) and move generator rearward.
3) Disconnect connector from crankshaft position sensor.
4) Remove crankshaft position sensor (1) from cylinder block.

Installation



1) Check to make sure that crankshaft position sensor and pulley teeth are free from any metal particles and damage.
2) Install crankshaft position sensor to cylinder block.
3) Connect connector to it securely.
4) Adjust generator belt tension, refer to “Water Pump/Generator Drive Belt Tension Inspection and Adjustment” in Section 6B.
5) Connect negative cable to battery.

Vehicle speed sensor (VSS) inspection

1) Confirm that terminal voltages and ground circuit continuity at VSS connector terminals are in good condition referring to Step 3 to 5 of “DTC P0500 Diag. Flow” in Section 6-1.
   If not, repair VSS circuit.
2) Check that VSS signal voltage varies from low to high or high to low as specified referring to Step 9 of “DTC P0500 Diag. Flow” in Section 6-1.
   If signal voltage varies as specified, VSS is in good condition.
   If not, replace VSS.

Vehicle speed sensor (VSS) removal and installation

Refer to “Vehicle Speed Sensor (VSS) Removal and Installation” in Section 7A1.

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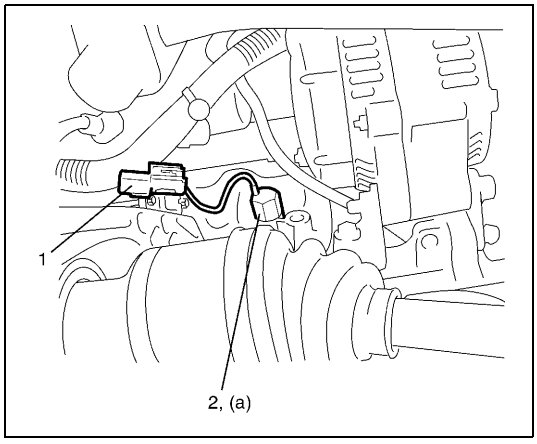
Knock sensor removal and installation

Removal

1) Disconnect negative cable from battery.
2) Hoist vehicle.
3) Remove engine harness bracket.



4) Disconnect knock sensor connector (1).
5) Remove knock sensor (2) from cylinder block.

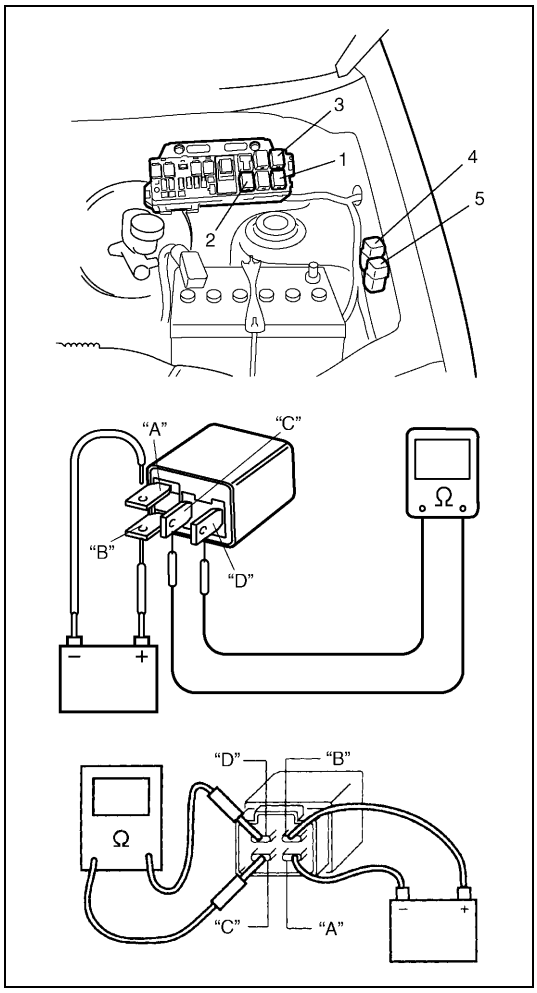
INSTALLATION

Reverse removal procedure for installation.

Tightening torque
Knock sensor (a): 22 N·m (2.2 kg-m, 16.0 lb-ft)

Main relay, fuel pump relay and radiator fan relay No.1, No.2, No.3 inspection

1) Disconnect negative cable at battery.



2) Remove main relay (1), fuel pump relay (2) and radiator fan control relay No.1 (3), No.2 (4), No.3 (5) from vehicle.
3) Check that there is no continuity between terminal "C" and "D". If there is continuity, replace relay.
4) Connect battery positive (+) terminal to terminal "B" of relay.
   Connect battery negative (–) terminal "A" of relay.
   Check continuity between terminal "C" and "D".
   If there is no continuity when relay is connected to the battery, replace relay.

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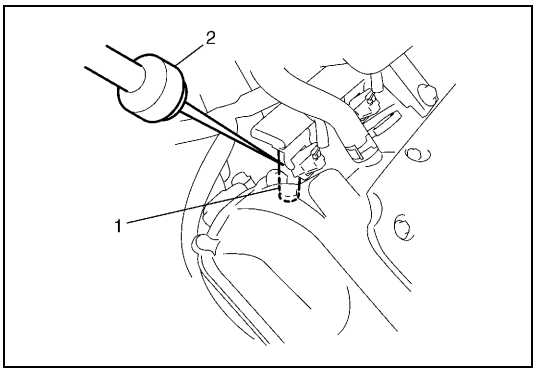
Fuel cut operation inspection

NOTE:

Before inspection, check to make sure that gear shift lever is in neutral position, A/C is OFF and that parking brake lever is pulled all the way up.



1) Warm up engine to normal operating temperature.
2) While listening to sound of injector (1) by using sound scope (2) or such, increase engine speed to higher than 3,000 r/min.
3) Check to make sure that sound to indicate operation of injector stops when throttle valve is closed instantly and it is heard again when engine speed is reduced to less than about 2,000 r/min.

Radiator fan control system inspection

WARNING:

Keep hands, tools, and clothing away from engine cooling fan to help prevent personal injury. This fan is electric and can come on whether or not the engine is running. The fan can start automatically in response to the ECT sensor with the ignition switch in the "ON" position.

Check system for operation referring to "Diag. Flow Table B-7" in Section 6-1.

If radiator fan fails to operate properly, check relay, radiator fan and electrical circuit.

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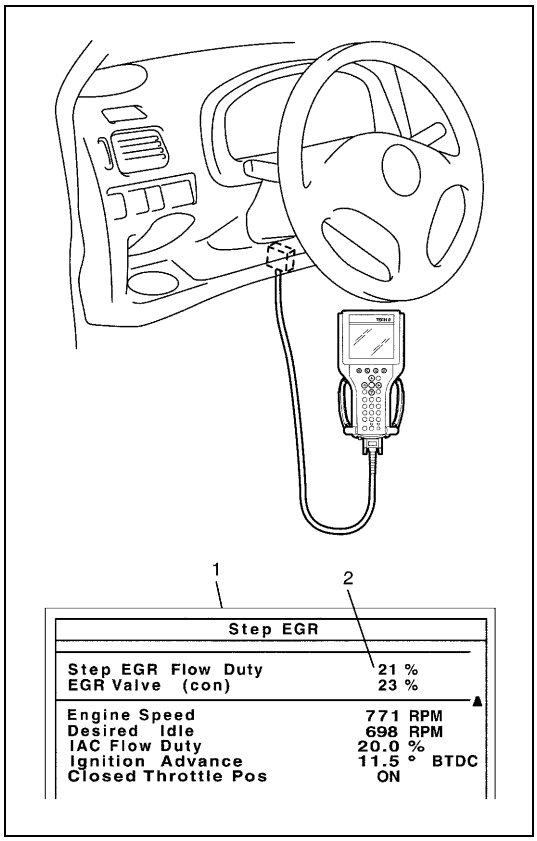
Emission Control System

EGR system inspection



1) Connect SUZUKI scan tool to data link connector (DLC) with ignition switch turn OFF.
2) Turn ON ignition switch and erase DTC using “CLEAR DTC” in “TROUBLU CODES” menu.
3) Start engine and warm up it to normal operating temperature then select “DTATA LIST” mode on scan tool.
4) Make sure that vehicle condition is as following.
   - Vehicle speed = 0 km/h (0 KPH)
   - Engine speed ≤900 rpm
   - Engine coolant temp. ≥ 90°C, 164°F
5) With engine idling (without depressing accelerator pedal), open EGR valve using “STEP EGR” mode in “MISC. TEST” menu.
   In this state, according as EGR valve opening increases engine idle speed drops. If not, possible cause is clogged EGR gas passage, stuck or faulty EGR valve.

1. SUZUKI scan tool display
2. EGR valve opening (0: Close, 100: Full Open)

EGR valve removal and installation

Removal

1) Disconnect negative cable at battery.
2) Remove air intake pipe.
3) Remove EGR pipe.
4) Disconnect EGR valve connector.
5) Remove EGR valve and gasket from cylinder head.

Installation

Reverse removal procedure noting following.

- Clean mating surface of valve and cylinder head.
- Use new gaskets.

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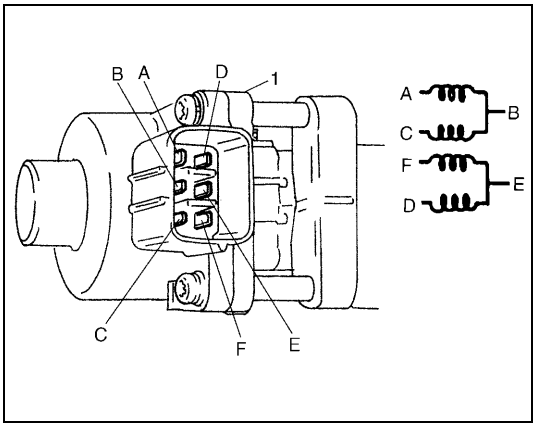
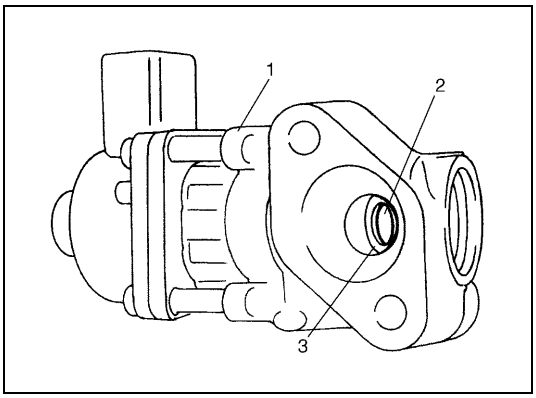
EGR valve inspection



1) Check resistance between following terminals of EGR valve (1) in each pair.
   If found faulty, replace EGR valve assembly.

EGR valve resistance

Terminal	Standard resistance
A – B C – B F – E D – E	20 – 24 Ω



2) Remove carbon from EGR valve gas passage.

NOTE:

Do not use any sharp–edged tool to remove carbon.
Be careful not to damage or bend EGR valve (1), valve seat (3) and rod.

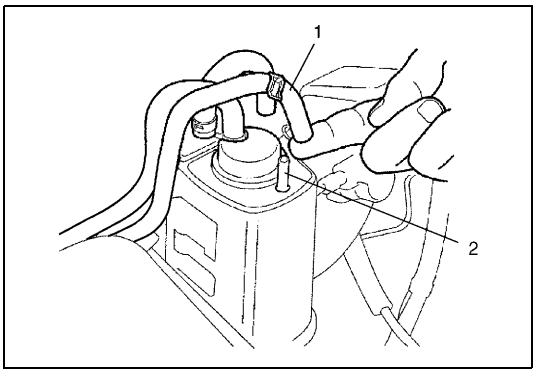
3) Inspect valve (2), valve seat and rod for fault, cracks, bend or other damage.
   If found faulty, replace EGR valve assembly.

Evaporative emission control system inspection

EVAP Canister Purge

NOTE:

Before inspection, check to make sure that gear shift lever is in neutral position and that parking brake lever is pulled all the way up.



1) Disconnect purge hose (1) from EVAP canister.
2) Place finger against the end of disconnected hose and check that vacuum is not felt there when engine is cool and running at idle speed.
   If check result is not satisfactory, check EVAP canister purge valve, wire harness and ECM.

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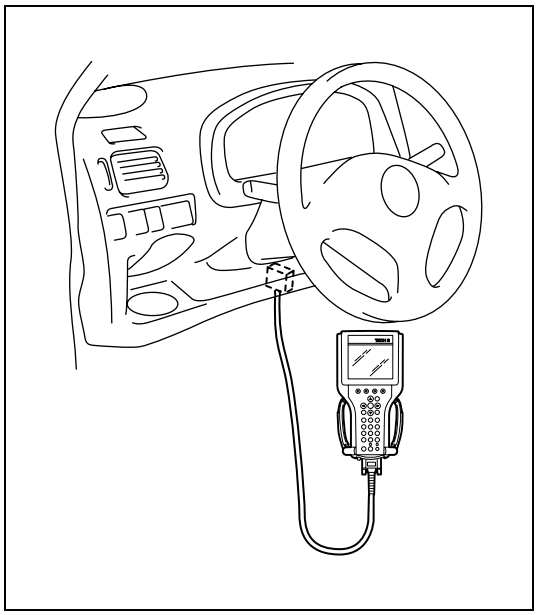
EVAP Canister Purge Valve and Its Circuit

1) Prepare to operate EVAP canister purge valve as follows.
   a) When using SUZUKI scan tool:



      i) Connect SUZUKI scan tool to DLC with ignition switch OFF and disconnect purge valve vacuum hoses from intake manifold and EVAP canister.
      ii) Turn ON ignition switch, clear DTC and select “MISC TEST” mode on SUZUKI scan tool.

   b) When not using SUZUKI scan tool:

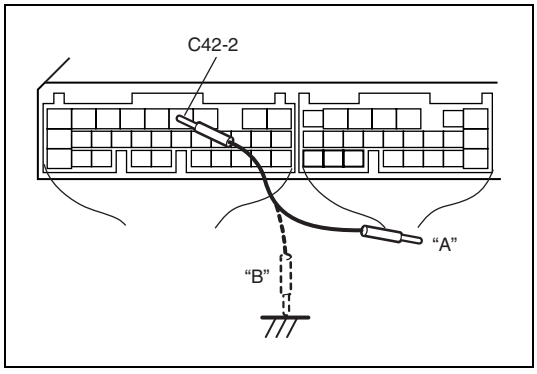
WARNING:

Do not apply vacuum by mouth; otherwise harmful fuel vapor can be breathed in.

CAUTION:

Do not apply vacuum more than –86 kPa (–12.47 Psi); otherwise EVAP canister purge valve could be damaged.

      i) Disconnect purge valve vacuum hoses from intake manifold and EVAP canister.



      ii) Turn ON ignition switch.
      Using service wire, ground C42-2 terminal of ECM connector (valve ON) “B” and unground it (valve OFF) “A”.

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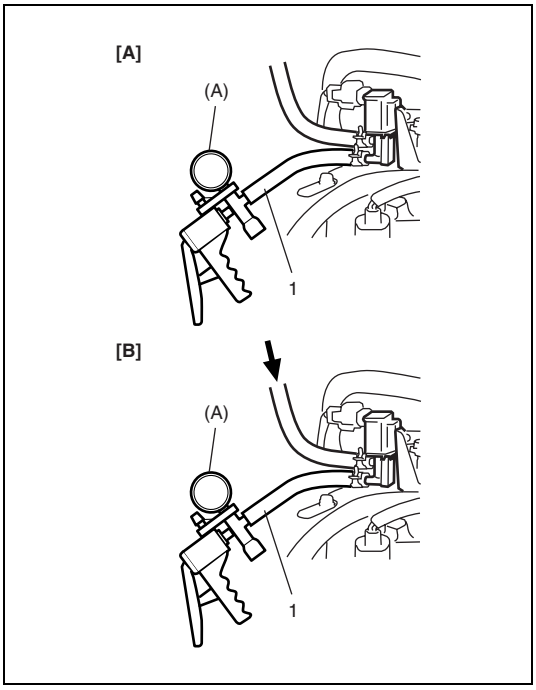
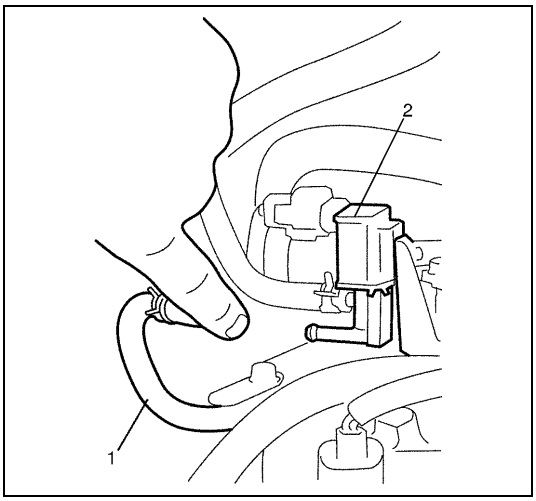


2) Check purge valve for operation and vacuum passage for clog when valve is switched ON and OFF by using SUZUKI scan tool or service wire.
If check result is not described, check vacuum hoses, EVAP canister purge valve, wire harness and connections.

EVAP canister purge valve specification
[A] Valve OFF:
When vacuum (–53 kPa (–7.69 Psi) to –67 kPa (–9.72 Psi)) is applied to hose (1), vacuum can be applied.
[B] Valve ON:
When vacuum (–53 kPa (–7.69 Psi) to –67 kPa (–9.72 Psi)) is applied to hose (1), vacuum can not be applied.

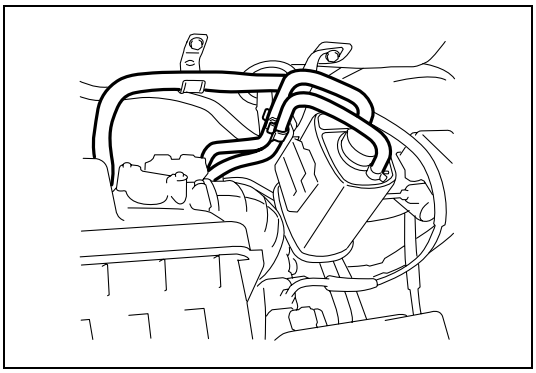
Special tool
(A): 09917-47911

Vacuum Passage



Start engine and run it at idle speed. Disconnect vacuum hose (1) from EVAP canister purge valve (2). With finger placed against hose disconnected, check that vacuum is applied.
If it is not applied, clean vacuum passage by blowing compressed air.

Vacuum Hose



Check hoses for connection, leakage, clog and deterioration. Replace as necessary.

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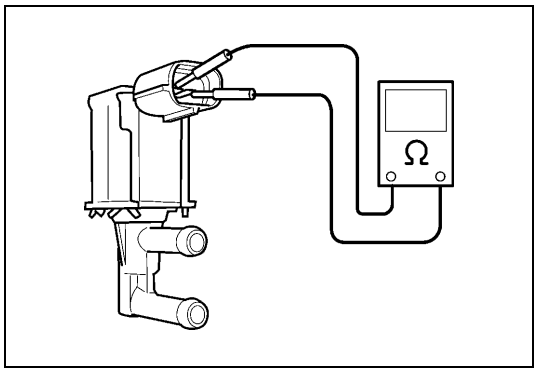
EVAP Canister Purge Valve

WARNING:
Do not apply vacuum by mouth; otherwise harmful fuel vapor can be breathed in.

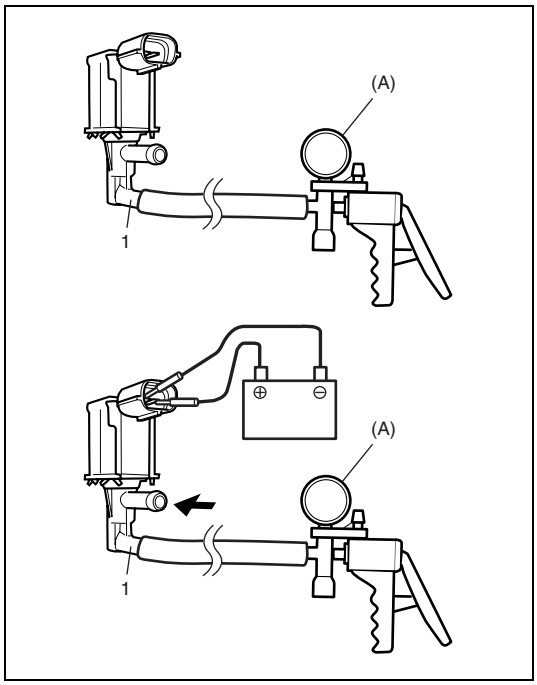
CAUTION:
Do not apply vacuum more than –86 kPa (–12.47 Psi); otherwise EVAP canister purge valve could be damaged.

1) With ignition switch OFF, disconnect coupler from canister purge valve.
2) Remove EVAP canister purge valve from air cleaner assembly.



3) Check resistance between two terminals of EVAP canister purge valve.
   If resistance is not as specified, replace.

EVAP canister resistance
30 – 34 Ω at 20°C (68°F)



4) With coupler disconnected, apply vacuum (–53 kPa (–7.69 Psi) to –67 kPa (–9.72 Psi)) to pipe (1).
   If vacuum can be applied, go to next step.
   If vacuum can not be applied, replace EVAP canister purge valve.
5) Connect 12 V-battery to EVAP canister purge valve terminals. In this state, apply vacuum (–53 kPa (–7.69 Psi) to –67 kPa (–9.72 Psi)) to pipe (1).
   If vacuum can not be applied, EVAP canister purge valve is in good condition.
   If applied, replace EVAP canister purge valve.

WARNING:
Do not suck the air through valve. Fuel vapor inside valve in harmful.

Special tool
(A): 09917-47911

6) Install EVAP canister purge valve to air cleaner assembly.

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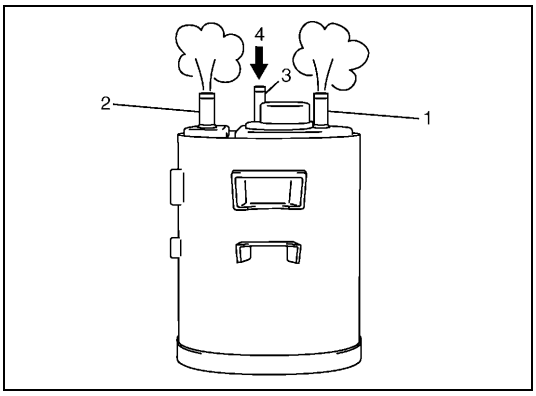
EVAP Canister

WARNING:
DO NOT SUCK nozzles on EVAP canister. Fuel vapor inside EVAP canister is harmful.

1) Check outside of EVAP canister visually.
2) Disconnect vacuum hoses from EVAP canister.
3) Check that there should be no restriction of flow through purge pipe (1) and air pipe (2) when air is blown (4) into tank pipe (3).
   If any faulty condition is found in above inspection, replace.



PCV system inspection

NOTE:
Be sure to check that there is no obstruction in PCV valve or its hoses before checking IAC duty, for obstructed PCV valve or hose hampers its accurate adjustment.

PCV Hose

Check hoses for connection, leakage, clog and deterioration.
Replace as necessary.

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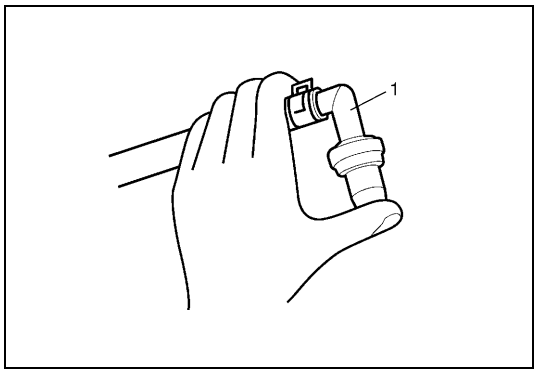
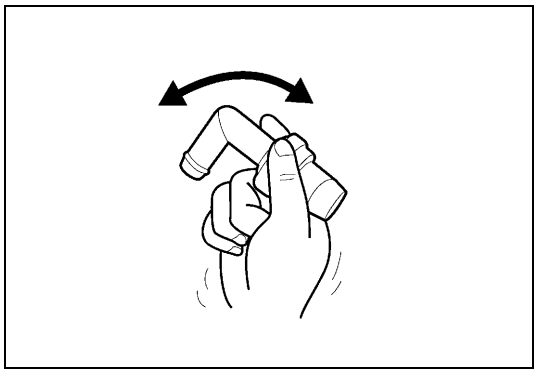
PCV Valve

1) Detach air cleaner assembly.
2) Disconnect PCV valve from cylinder head cover and install plug to head cover hole.
3) Install air cleaner assembly temporarily.
4) Run engine at idle.



5) Place your finger over end of PCV valve (1) to check for vacuum.
   If there is no vacuum, check for clogged valve. Replace as necessary.



6) After checking vacuum, stop engine and remove PCV valve. Shake valve and listen for the rattle of check needle inside the valve. If valve does not the rattle, replace valve.

7) After checking, remove plug and install PCV valve.
8) Install air cleaner assembly securely.

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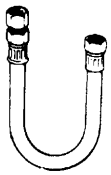
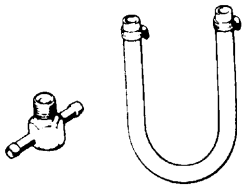
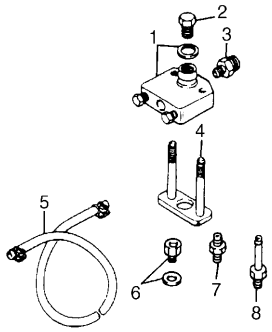
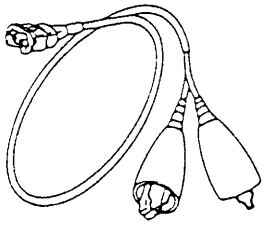
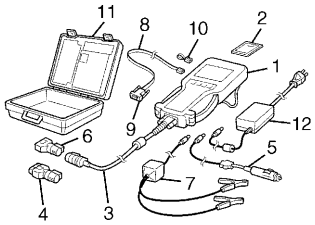
Special Tool

 09912-58442 Pressure gauge	 09912-58432 Pressure hose	 09912-58490 3-way joint & hose	 09912-58421 Checking tool set (See NOTE “A”.)
 09912-57610 Checking tool plate	 09930-88530 Injector test lead	 Tech 2 kit (SUZUKI scan tool) (See NOTE “B”.)	

NOTE:

- **“A”: This kit includes the following items.**
  1. Tool body & washer, 2. Body plug, 3. Body attachment-1, 4. Holder, 5. Return hose & clamp, 6. Body attachment-2 & washer, 7. Hose attachment-1, 8. Hose attachment-2
- **“B”: This kit includes the following items.**
  1. Tech 2, 2. PCMCIA card, 3. DLC cable, 4. SAE 16/19 adaptor, 5. Cigarette cable, 6. DLC loopback adaptor, 7. Battery power cable, 8. RS232 cable, 9. RS232 adaptor, 10. RS 232 loopback connector, 11. Storage case, 12. Power supply

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Tightening Torque Specification

Fastening part	Tightening torque		
	N•m	kg-m	lb-ft
TP sensor screw	2.5	0.25	1.8
IAC valve screw	3.5	0.35	2.5
ECT sensor	15	1.5	11.5
Heated oxygen sensor	45	4.5	32.5
Camshaft position sensor bolt	10	1.0	7.5
Knock sensor	22	2.2	16.0
Oil control valve mounting nut	11	1.1	8.0
Oil gallery pipe No.1 bolt	30	3.0	21.5
Delivery pipe bolt	25	2.5	18.0
Acclerator cable lock nut	12	1.2	9.0

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SECTION 6F1

IGNITION SYSTEM (ELECTRONIC IGNITION SYSTEM)

WARNING:

For vehicles equipped with Supplemental Restraint (Air Bag) System:

- **Service on and around the air bag system components or wiring must be performed only by an authorized SUZUKI dealer. Refer to "Air Bag System Components and Wiring Location View" under "General Description" in Section 10B in order to confirm whether you are performing service on or near the air bag system components or wiring. Please observe all WARNINGS and "Service Precautions" under "On-Vehicle Service" in Section 10B before performing service on or around the air bag system components or wiring. Failure to follow WARNINGS could result in unintentional activation of the system or could render the system inoperative. Either of these two conditions may result in severe injury.**
- **Technical service work must be started at least 90 seconds after the ignition switch is turned to the "LOCK" position and the negative cable is disconnected from the battery. Otherwise, the system may be activated by reserve energy in the Sensing and Diagnostic Module (SDM).**

NOTE:

For the items with asterisk (*) in the "CONTENTS" below, refer to the same section of the Service Manual mentioned in FOREWORD of this manual.

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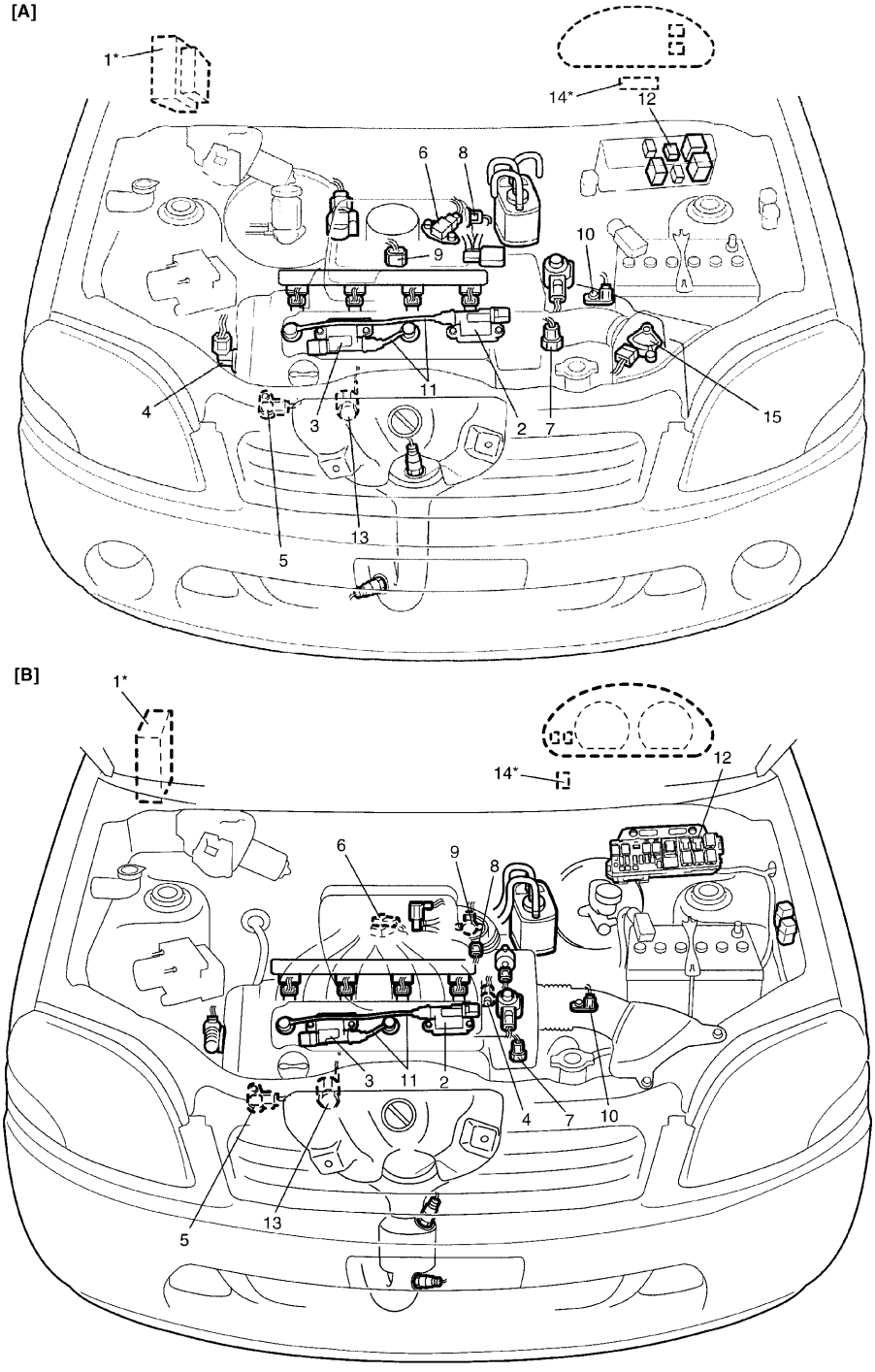
General Description

System Components



[A]: M13 engine	5. CKP sensor	11. High-tension cords
[B]: M15 engine	6. MAP sensor	12. Monitor connector (if equipped)
1. ECM	7. ECT sensor	13. Knock sensor
2. Ignition coil assembly for No.1 and No.4 spark plugs	8. IAT sensor	14. Data link connector
3. Ignition coil assembly for No.2 and No.3 spark plugs	9. TP sensor	15. Transmission range switch (A/T)
4. CMP sensor	10. VSS	

NOTE:

Above figure shows left-hand steering vehicle. For right-hand steering vehicle, parts with (*) are installed at the opposite side.

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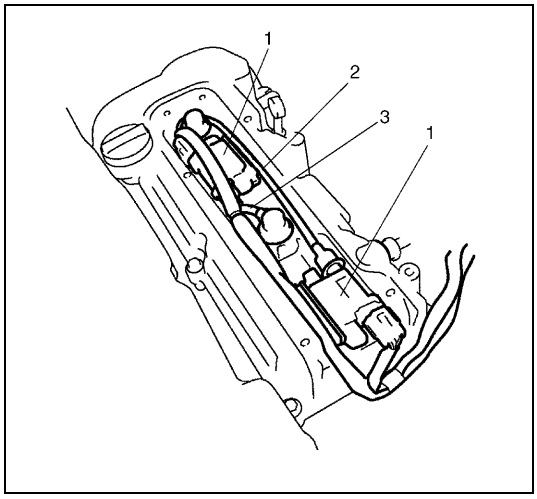
On-Vehicle Service

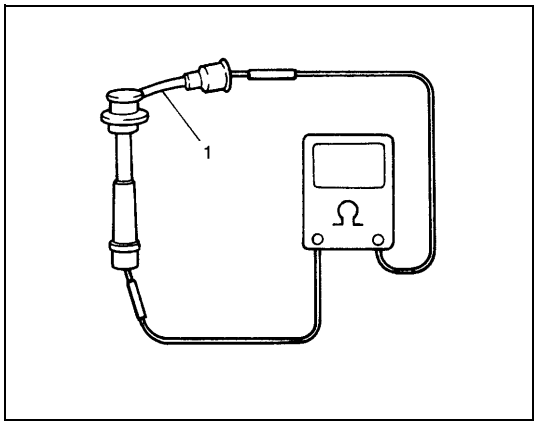
High-Tension Cords

1) Remove air cleaner assembly (for M15 engine only), air intake pipe and cylinder head upper cover.



2) Disconnect No.1 cylinder (2) and No.3 cylinder (3) high-tension cords from ignition coil assemblies (1) while gripping each cap.
3) Pull out high-tension cords from spark plugs while gripping each cap.

CAUTION:
- **Removal of high-tension cords together with clamps will be recommended so as not to damage their inside wire (resistive conductor).**
- **For the same reason, pull out each connection by gripping cap portion.**

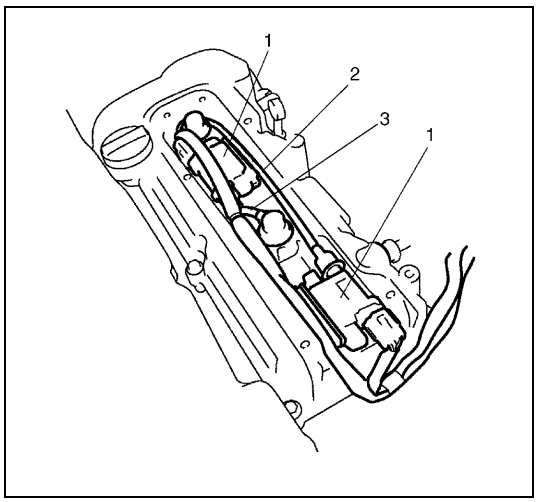


4) Measure resistance of high-tension cord (1) by using ohmmeter.
   If resistance exceeds specification, replace high-tension cord(s).

High-tension cord resistance

No.1 cylinder high-tension cord resistance
1.4 – 4.0 kΩ

No.3 cylinder high-tension cord resistance
0.6 – 2.0 kΩ



5) Install No.1 cylinder (2) and No.3 cylinder (3) high-tension cords to spark plugs and ignition coil assemblies (1) while gripping each cap.

CAUTION:
- **Never attempt to use metal conductor high-tension cords as replacing parts.**
- **Insert each cap portion fully when installing high-tension cords.**

6) Install cylinder head upper cover, air cleaner assembly (for M15 engine only) and air intake pipe.

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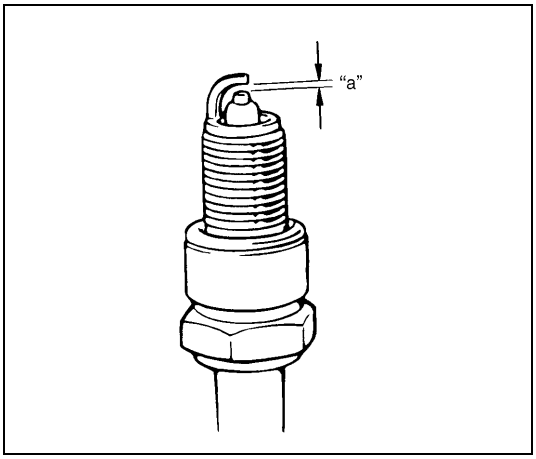
Spark Plugs

CAUTION:
- **When servicing the iridium/platinum spark plugs (slender center electrode type plugs), do not touch the center electrode to avoid damage to it. The electrode is not strong enough against mechanical force as it is slender and its material is not mechanically tough.**
- **Do not clean or adjust gap for the iridium/platinum spark plugs.**

1) Remove air cleaner assembly (for M15 engine only), air intake pipe and cylinder head upper cover.
2) Pull out high-tension cords by gripping their caps and then remove ignition coil assemblies referring to “Ignition Coil Assembly (Including Ignitor)” in this section.
3) Remove spark plugs.
4) Inspect them for:
   - Electrode wear
   - Carbon deposits
   - Insulator damage



5) If any abnormality is found, for nickel spark plugs, adjust air gap, clean with spark plug cleaner or replace them with specified new pugs.
   For iridium/platinum spark plugs, replace them with new plugs.

Spark plug air gap
“a”: 1.0 – 1.1 mm (0.040 – 0.043 in.)

Spark plug type
NGK: BKR6E-11 (Nickel spark plug), IFR6J11 (Iridium spark plug)
DENSO: K20PR-U11 (Nickel spark plug)

NOTE:

NGK IFR6J11 is highly recommended for better engine starting performance under –25°C (–13°F).

6) Install spark plugs and torque them to specification.

Tightening torque
Spark plug: 25 N·m (2.5 kg-m, 18.0 lb-ft)

7) Install ignition coil assemblies referring to “Ignition Coil Assembly (Including Ignitor)” in this section.
8) Install high-tension cords securely by gripping their caps.
9) Install cylinder head upper cover, air cleaner assembly (for M15 engine only) and air intake pipe.

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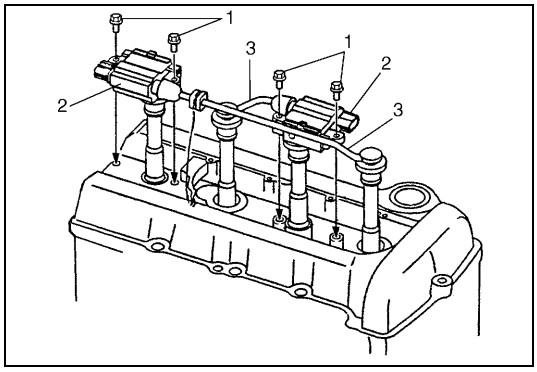
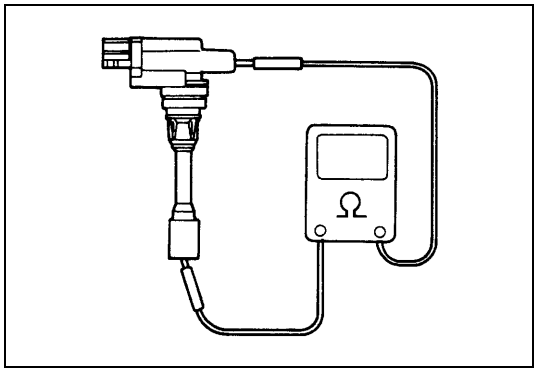
Ignition Coil Assembly (Including Ignitor)

Inspection

1) Disconnect negative cable at battery.
2) Remove air cleaner assembly (for M15 engine only), air intake pipe and cylinder head upper cover.
3) Disconnect ignition coil coupler.

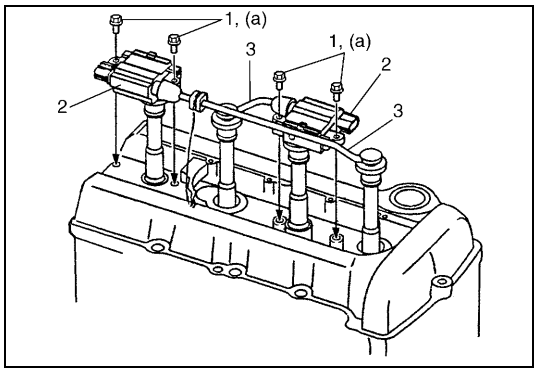


4) Disconnect high-tension cord (3) from ignition coil assembly (2).
5) Remove ignition coil bolts (1) and then pull out ignition coil assembly.



6) Measure secondary coil for resistance.
   If resistance is out of specification, replace ignition coil assembly.

Secondary coil resistance
7.6 – 10.2 kΩ at 20°C, 68°F



7) Install ignition coil assembly (2).
8) Tighten ignition coil bolts (1) to specified torque, and then connect ignition coil coupler.

Tightening torque
Ignition coil bolt
(a): 10 N·m (1.0 kg-m, 7.5 lb-ft)

9) Install high-tension cord (3) to ignition coil assembly while gripping its cap.
10) Install cylinder head upper cover, air cleaner assembly (for M15 engine only) and air intake pipe.
11) Connect negative cable to battery.

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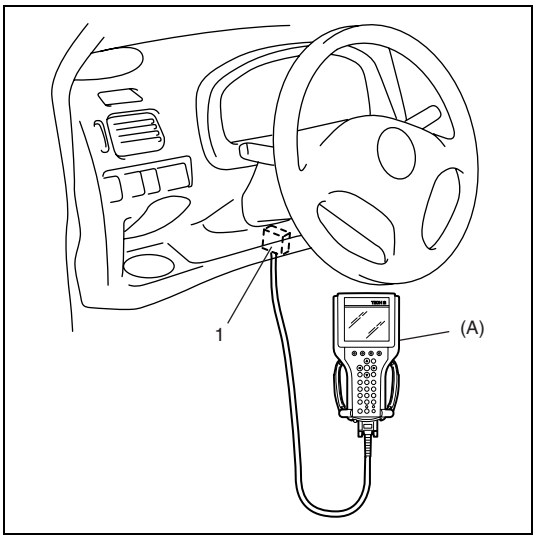
Ignition Timing

NOTE:

- **Ignition timing is not adjustable. If ignition timing is out of specification, check system related parts.**
- **Before starting engine, place transmission gear shift lever in "Neutral" (shift selector lever to "P" range for A/T model), and set parking brake.**

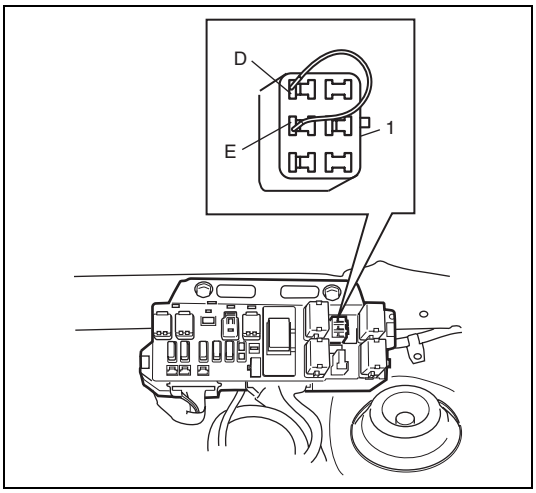
Inspection



1) When using scan tool, connect scan tool to DLC (1) with ignition switch OFF.

   Special tool
   (A): SUZUKI scan tool

2) Start engine and warm it up to normal operating temperature.
3) Make sure that all of electrical loads except ignition are switched off.
4) Check to be sure that idle speed is within specification referring to "Idle Speed/Idle Air Control (IAC) Duty Inspection" in Section 6E1 or 6E2.



5) Fix ignition timing to initial one as follows.
   Select "MISC" mode on scan tool and fix ignition timing to initial one.
   If scan tool is not available, connect D and E terminals of monitor connector (1) by using service wire so that ignition timing is fixed on initial one.

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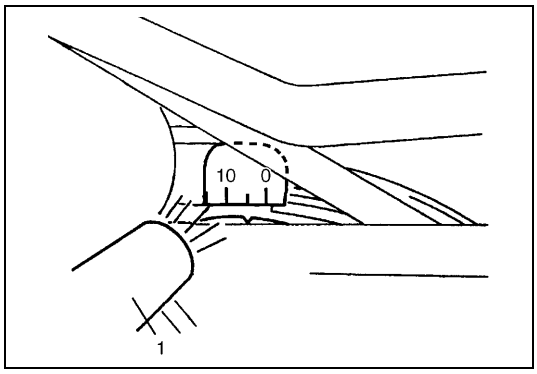

6) Using timing light (1), check that ignition timing is within specification.

Initial ignition timing (test switch terminal grounded or fixed with scan tool)
5 ± 3° BTDC at idle speed

Ignition order
1-3-4-2

7) If ignition timing is out of specification, check the followings:
   - CKP sensor
   - CKP sensor plate
   - CMP sensor
   - CMP sensor rotor tooth of camshaft
   - TP sensor
   - Test switch signal circuit
   - VSS
   - Timing chain cover installation
8) After checking Initial Ignition Timing, release ignition timing fixation by using scan tool or disconnect service wire from monitor connector.
9) With engine idling (test switch terminal ungrounded, throttle opening at closed position and car stopped), check that ignition timing is about 3° – 13° BTDC. (Constant variation within a few degrees from 3° – 13° indicates no abnormality but proves operation of electronic timing control system.) Also, check that increasing engine speed advances ignition timing. If above check results are not satisfactory, check CKP sensor, test switch terminal circuit and ECM.

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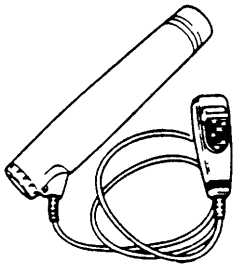
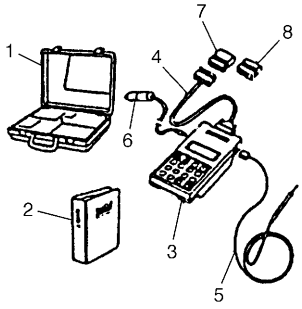
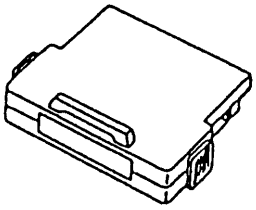
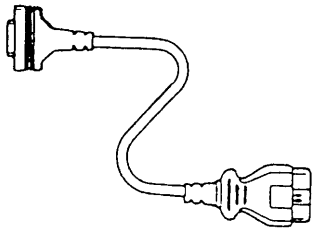
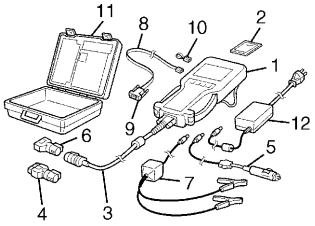
Tightening Torque Specification

Fastening part	Tightening torque		
	N•m	kg-m	lb-ft
Spark plug	25	2.5	18.0
Ignition coil bolt	10	1.0	7.5

Special Tool

 09930-76420 Timing light (Dry cell type)	 09931-76011 Tech 1A kit (SUZUKI scan tool) (See NOTE “A”.)	 Mass storage cartridge for Tech 1A	 09931-76030 16/14 pin DLC cable for Tech 1A
 Tech 2 kit (SUZUKI scan tool) (See NOTE “B”.)			

NOTE:

- **“A”: This kit includes the following items and is usable only for M13 engine.**
  1. Storage case, 2. Operator’s manual, 3. Tech 1A, 4. DLC cable, 5. Test lead/probe, 6. Power source cable, 7. DLC cable adaptor, 8. Self-test adaptor
- **“B”: This kit includes the following items and is usable for M13 and M15 engines.**
  1. Tech 2, 2. PCMCIA card, 3. DLC cable, 4. SAE 16/19 adapter, 5. Cigarette cable, 6. DLC loopback adapter, 7. Battery power cable, 8. RS232 cable, 9. RS232 adapter, 10. RS232 loopback connector, 11. Storage case, 12. Power supply

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SECTION 6K

EXHAUST SYSTEM

NOTE:

For the items with asterisk (*) in the "CONTENTS" below, refer to the same section of the Service Manual mentioned in "FOREWORD" of this manual.

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Exhaust System Component 6K-2
Exhaust Manifold ..... *
Exhaust Pipe ..... *

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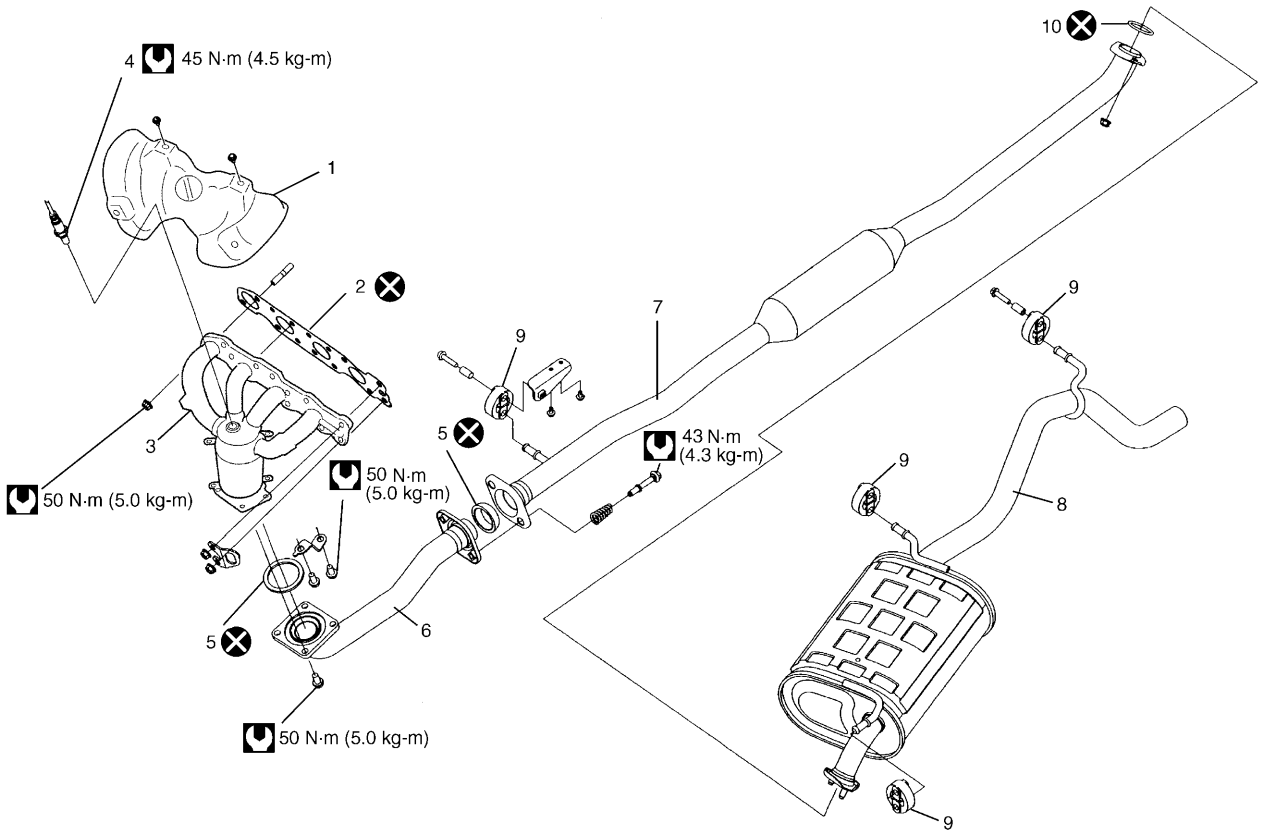
On-Vehicle Service

Exhaust System Component

WARNING:

To avoid the danger of being burned, do not touch the exhaust system when the system is hot. Any service on the exhaust system should be performed when the system is cool.

M13 engine model



1. Exhaust manifold cover	5. Seal ring	9. Muffler mounting
2. Gasket	6. Exhaust No.1 pipe	10. Gasket
3. Exhaust manifold	7. Exhaust No.2 pipe	Tightening torque
4. Oxygen sensor	8. Muffler	Do not reuse.

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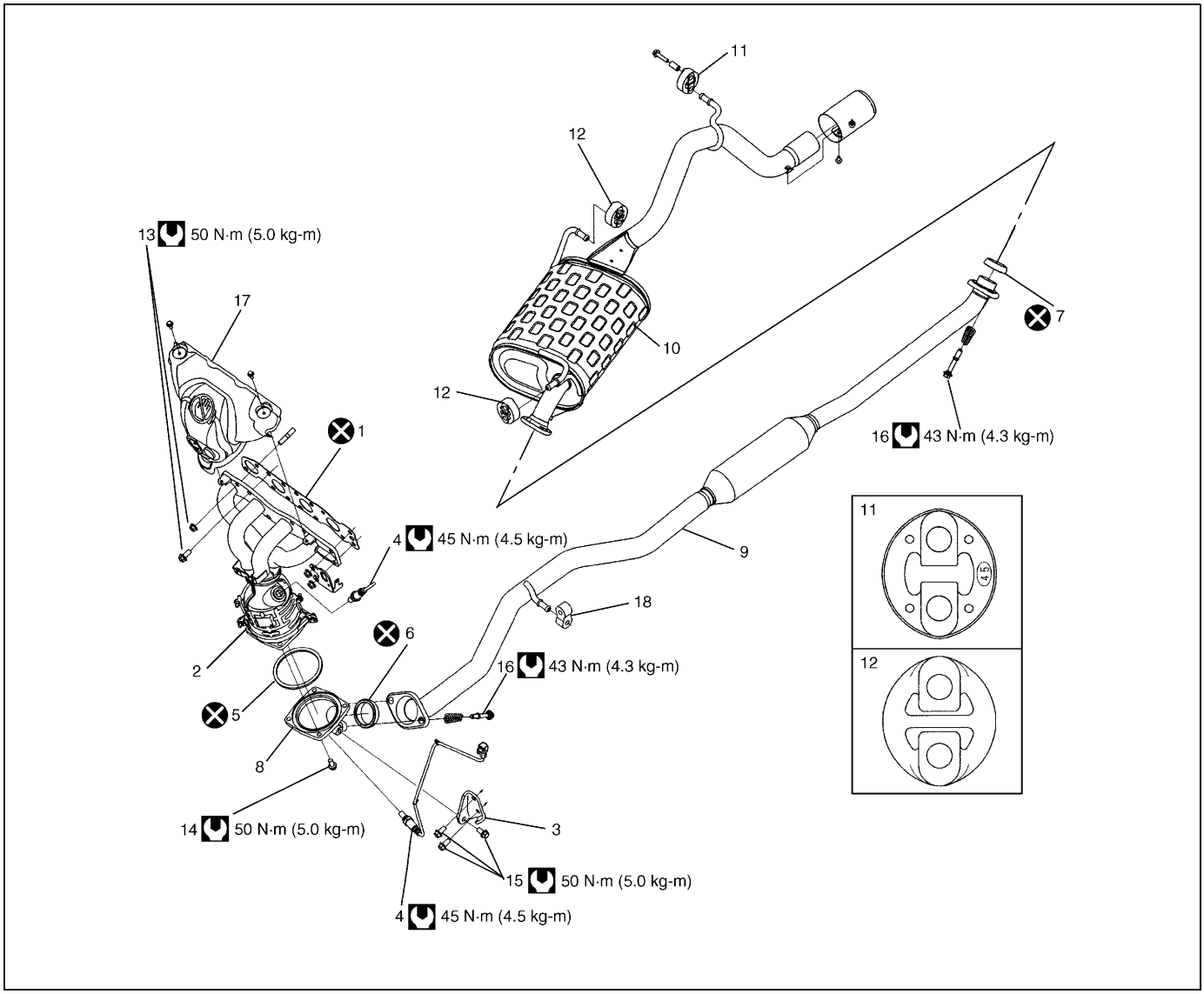
M15 engine model



1. Gasket	8. Exhaust No.1 pipe	15. Exhaust manifold stiffener bolt
2. Exhaust manifold	9. Exhaust No.2 pipe	16. Exhaust No.2 pipe bolt
3. Exhaust No.1 pipe stiffener	10. Muffler	17. Exhaust manifold cover
4. Oxygen sensor (if equipped)	11. Muffler mounting No.1	18. Muffler mounting type 3
5. Exhaust pipe gasket	12. Muffler mounting No.2	Tightening torque
6. Seal ring No.1	13. Exhaust manifold bolt and nut	Do not reuse.
7. Seal ring No.2	14. Exhaust No.1 pipe bolt	

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SECTION 7A

MANUAL TRANSMISSION (M13 ENGINE)

WARNING:

For vehicles equipped with Supplemental Restraint (Air Bag) System :

- **Service on and around the air bag system components or wiring must be performed only by an authorized SUZUKI dealer. Refer to "Air Bag System Components and Wiring Location View" under "General Description" in air bag system section in order to confirm whether you are performing service on or near the air bag system components or wiring. Please observe all WARNINGS and "Service Precautions" under "On-Vehicle Service" in air bag system section before performing service on or around the air bag system components or wiring. Failure to follow WARNINGS could result in unintentional activation of the system or could render the system inoperative. Either of these two conditions may result in severe injury.**
- **Technical service work must be started at least 90 seconds after the ignition switch is turned to the "LOCK" position and the negative cable is disconnected from the battery. Otherwise, the system may be activated by reserve energy in the Sensing and Diagnostic Module (SDM).**

NOTE:

- **For the items with asterisk (*) in the "CONTENTS" below, refer to the same section of the Service Manual mentioned in "FOREWORD" of this manual.**
- **Use the SUZUKI BOND NO. 1217G (99000-31260) instead of the SUZUKI BOND NO. 1215B (99000-31110) which is instructed in the same section of the Service Manual mentioned in "FOREWORD" of this Manual.**

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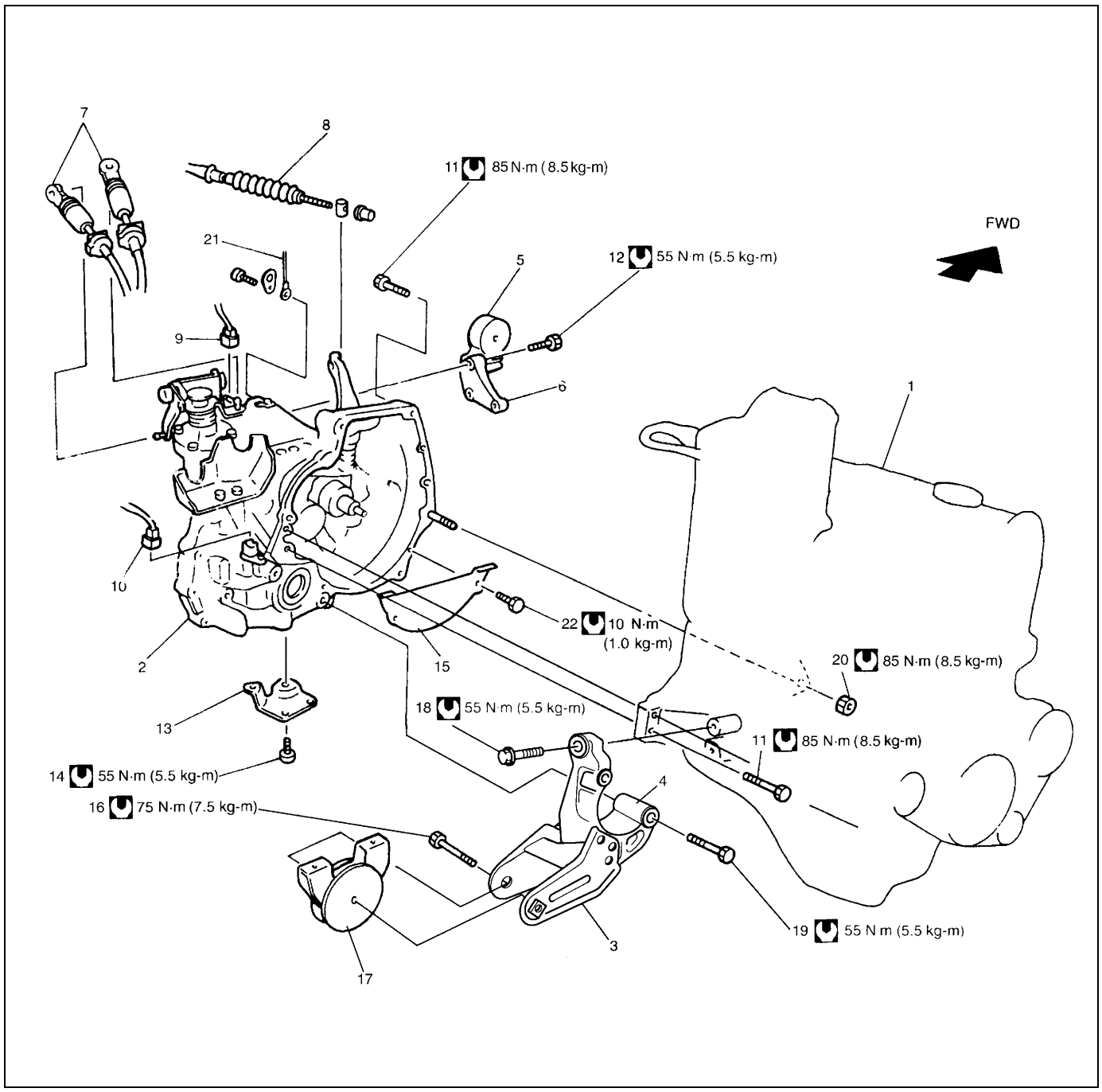
Unit Repair Overhaul

Transmission Unit



1. Engine	9. Backup lamp switch connector	17. Engine rear mounting
2. Transmission	10. VSS connector	18. Engine rear mounting No.2 bracket bolts
3. Engine rear mounting No.1 bracket	11. Transmission to engine bolts	19. Transmission to engine rear mounting No.2 bracket bolt
4. Engine rear mounting No.2 bracket	12. Engine left mounting bracket bolts	20. Transmission to engine nut
5. Engine left mounting	13. Engine rear mounting bracket stiffener	21. Ground cable
6. Engine left mounting bracket	14. Stiffener bolts	22. Clutch housing lower plate bolts
7. Shift & select control cables	15. Clutch housing lower plate	Tightening torque
8. Clutch cable	16. Engine rear mounting bolt	

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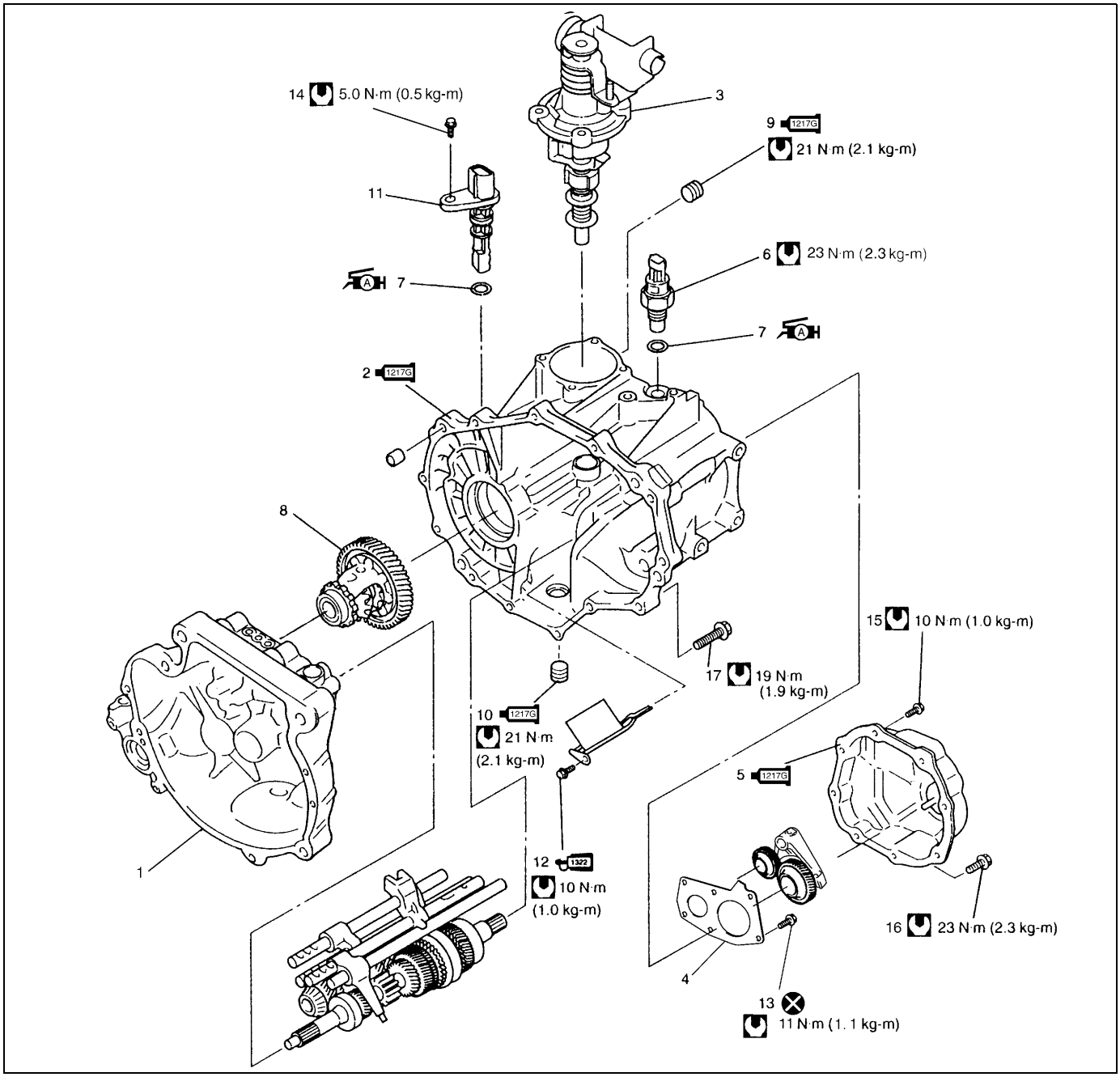
Trasmission Case



	1. Transmission right case		11. VSS
1217G	2. Transmission left case : Apply sealant 99000-31260 to mating surface of left case and right case.	1322	12. Oil gutter bolt : Apply thread lock 99000-32110 to all around thread part of bolt.
	3. Gear shifter assembly		13. Left case plate screw
	4. Transmission left case plate		14. VSS bolt
1217G	5. Transmission side cover : Apply sealant 99000-31260 to mating surface of side cover and left case.		15. Side cover bolt No.1
	6. Backup lamp switch		16. Side cover bolt No.2
A H	7. O-ring : Apply SUZUKI SUPER GREASE A 99000-25010 to O-ring.		17. Transaxle case bolt
	8. Differential assembly		Tightening torque
1217G	9. Oil level/filler plug : Apply sealant 99000-31260 to all around thread part of plug.		Do not reuse.
1217G	10. Oil drain plug : Apply sealant 99000-31260 to all around thread part of plug.		

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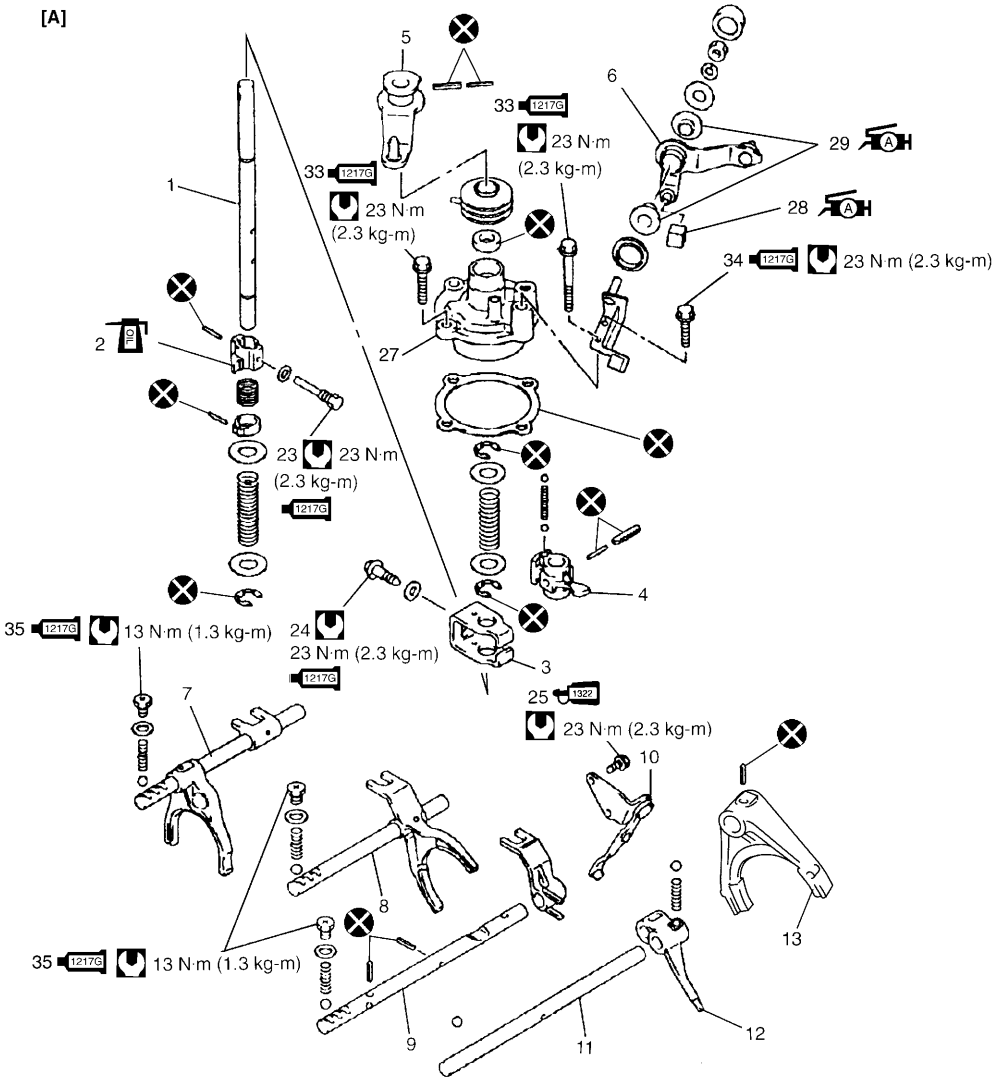
Gear Shifter and Differential



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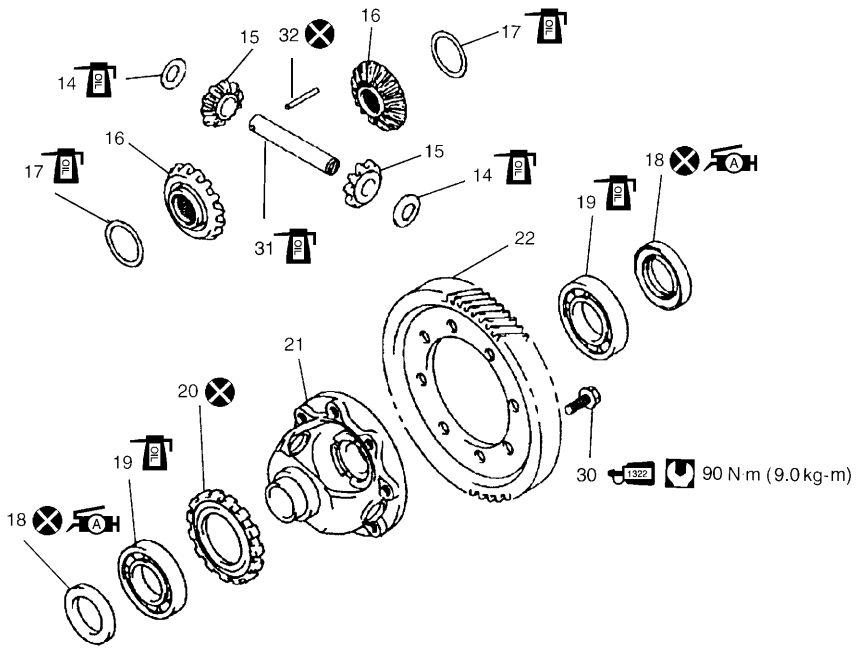
[B]



[A]: Gear shifter	13. 5th gear shift fork	27. Guide case	
[B]: Differential	14. Side gear washer	28. Select lever shaft bush : Apply grease 99000-25010 to whole area of bush.	
1. Gear shift & select shaft	15. Differential side pinion gear	29. Select lever boss : Apply grease 99000-25010 to internal and external diameter	
2. 5th & reverse gear shift cam	16. Differential side gear	30. Final gear bolt : Apply thread lock 99000-32110 to all around thread part of bolt	
3. Gear shift interlock plate	17. Side gear washer	31. Differential pinion shaft	
4. Gear shift & select lever	18. Differential side oil seal : Apply grease 99000-25010 to oil seal lip.	32. Differential pinion shaft pin	
5. Shift cable lever	19. Differential side bearing	33. Gear shift guide case bolt : Apply sealant 99000-31260 to bolt thread.	
6. Select cable lever	20. Speed sensor ring	34. Select lever bracket bolt : Apply sealant 99000-31260 to bolt thread.	
7. Low speed gear shift shaft	21. Differential case	35. Gear shift locating bolt : Apply sealant 99000-31260 to bolt thread.	
8. High speed gear shift shaft	22. Final gear	Tightening torque	
9. 5th & reverse gear shift shaft	23. 5th to reverse interlock guide bolt : Apply sealant 99000-31260 to bolt thread.	Do not reuse.	
10. Reverse gear shift lever	24. Gear shift interlock bolt : Apply sealant 99000-31260 to bolt thread.	Apply transmission oil.	
11. 5th & reverse gear shift guide shaft	25. Reverse gear shift lever bolt : Apply thread lock 99000-32110 to all around thread part of bolt.		
12. Reverse gear shift arm	26. Blank		

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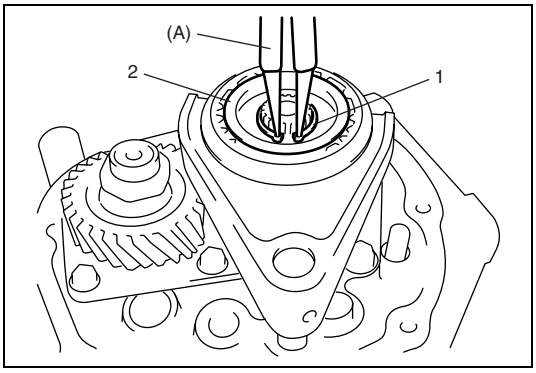
Unit Disassembly

Fifth gears

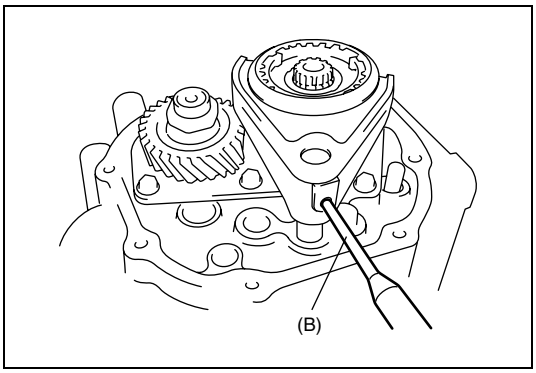
1) Remove side cover bolts and take off transmission side cover.

CAUTION:
Care should be taken not to distort side cover when it is removed from left case.



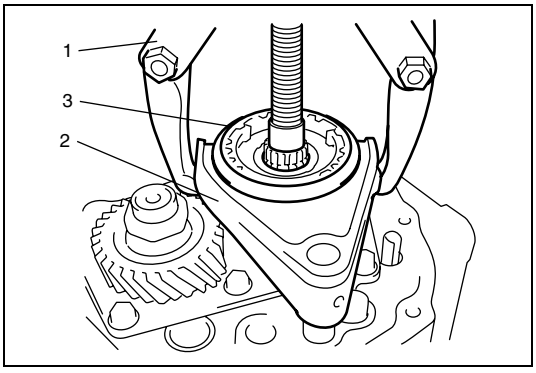
2) Using special tool, remove circlip (1) and then hub plate (2).

Special tool
(A): 09900-06107

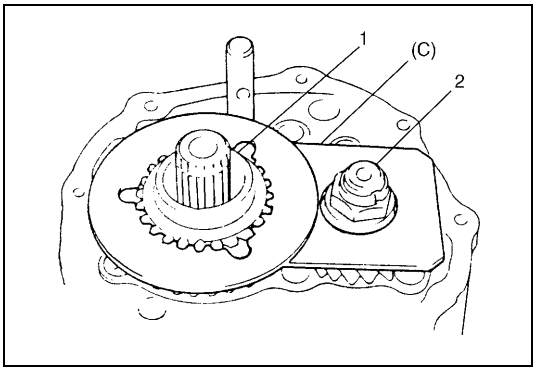


3) Drive out spring pin by using special tool and hammer.

Special tool
(B): 09922-85811



4) Remove gear shift fork (2), sleeve & hub assembly (3), synchronizer ring spring, synchronizer ring and 5th gear all together. Use gear puller (1) for removal if spline fitting of hub is tight.



5) Unfasten caulking of countershaft nut, install input shaft 5th gear (1) and special tool to stop rotation of shafts, and then remove countershaft nut (2).

Special tool
(C): 09927-76010

6) Remove special tool, input shaft 5th gear, needle bearing of separated steel cage type and then counter shaft 5th gear.

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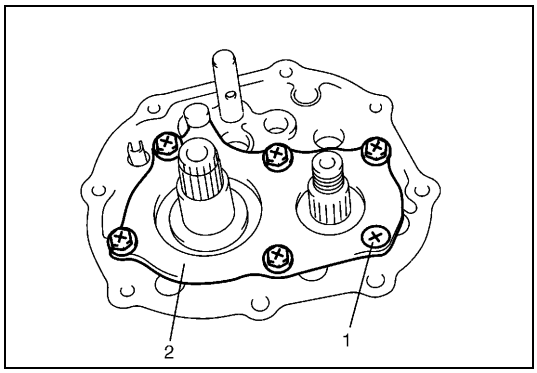
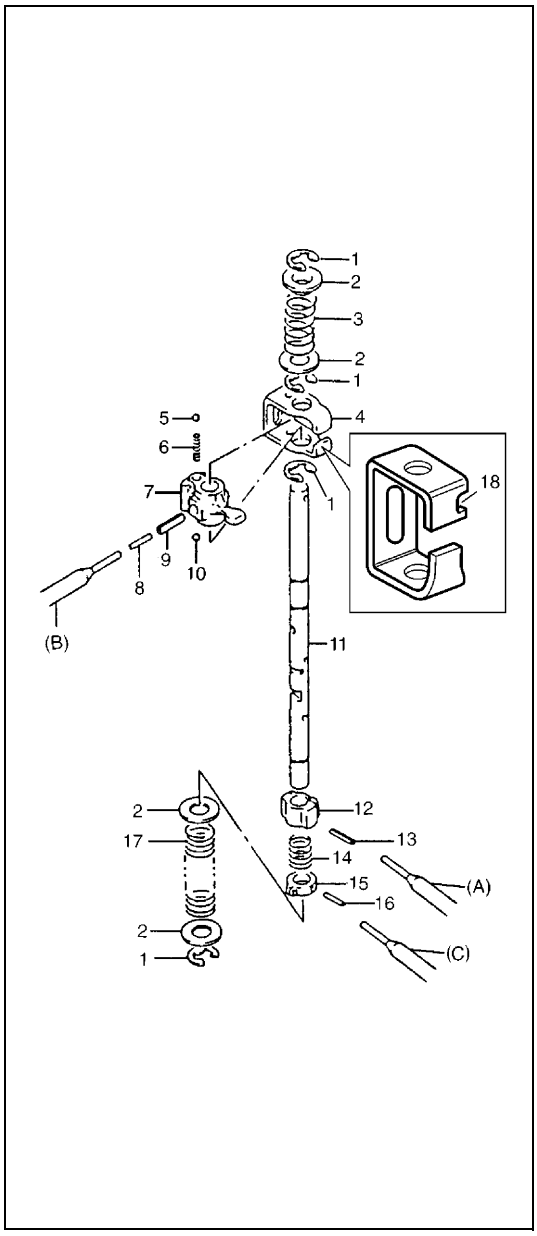


7) Remove plate screws (1) and take off left case plate (2), and then bearing set shim.

Sub Assembly Service

Gear Shifter

Gear Shift and Select Shaft Assembly



1) Push spring pins out using specified spring pin removers as shown bellow.

Special tool
(A): 09922-85811 (4.5 mm)
(B): 09925-78210 (6.0 mm)
(C): 2.8 – 3.0 mm (0.11 – 0.12 in.) Commercially available spring pin remover

2) Inspect component parts for wear, distortion or damage. If any detect is found, replace detective part with new one.

NOTE:

- **Gear shift interlock plate has a specific installation direction. Install it by locating notch (18) at the side of shift cable lever.**
- **When driving in spring pins, prevent shaft from being bent by supporting it with wood block.**
- **Assemble 5th & reverse gear shift cam with its pit and spring pin aligned.**
- **Make sure to select an appropriate spring by identifying the painted colors to keep gear shifting performance as designed.**
  - **– Low speed select spring (17) - No paint**
  - **– Reverse select spring (3) - Pink**

1. E-ring	10. Ball
2. Washer	11. Gear shift & select shaft
3. Reverse select spring	12. 5th & reverse gear shift cam
4. Gear shift interlock plate	13. Spring pin
5. Ball	14. Cam guide return spring
6. Gear shift interlock spring	15. 5th & reverse gear shift cam guide
7. Gear shift & select lever	16. Spring pin
8. Spring pin	17. Low speed select spring
9. Spring pin	18. Notch

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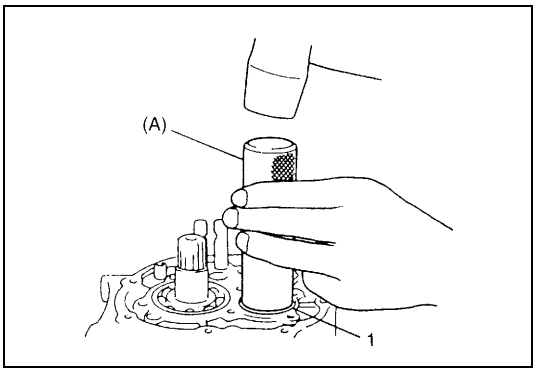
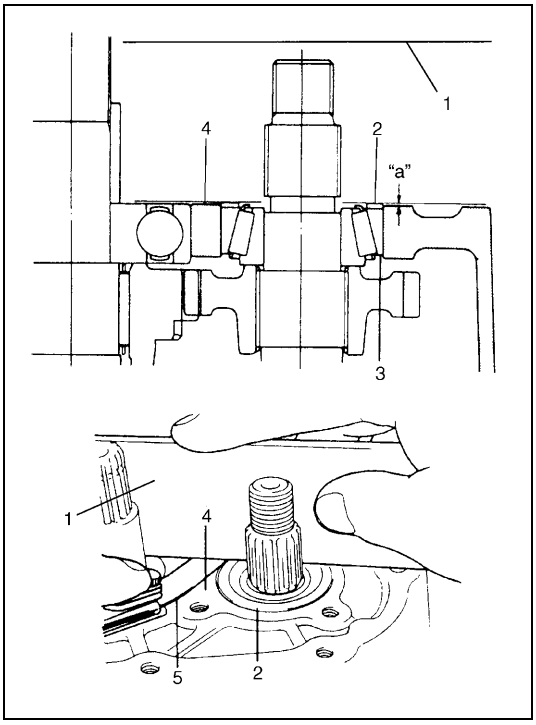
Unit Assembly

Fifth gears



1) To seat countershaft left bearing cup (1) to bearing cone, tap cup by using special tool and plastic hammer.

Special tool
(A): 09913-84510



2) Put a shim (2) on bearing cup (3) provisionally, place straight edge (1) over it and compress it by hand through straight edge, and then measure "a" (Clearance between case surface (4) and straight edge) by using feeler gauge (5).

Clearance between case surface and straight edge
"a": 0.13 – 0.17 mm (0.0051 – 0.0067 in.)
(Shim protrusion)

3) By repeating above step, select a suitable shim which adjusts clearance "a" to specification and put it on bearing cup.

NOTE:

Insert 0.15 mm (0.0059 in.) feeler to know whether or not a shim fulfills specification quickly.

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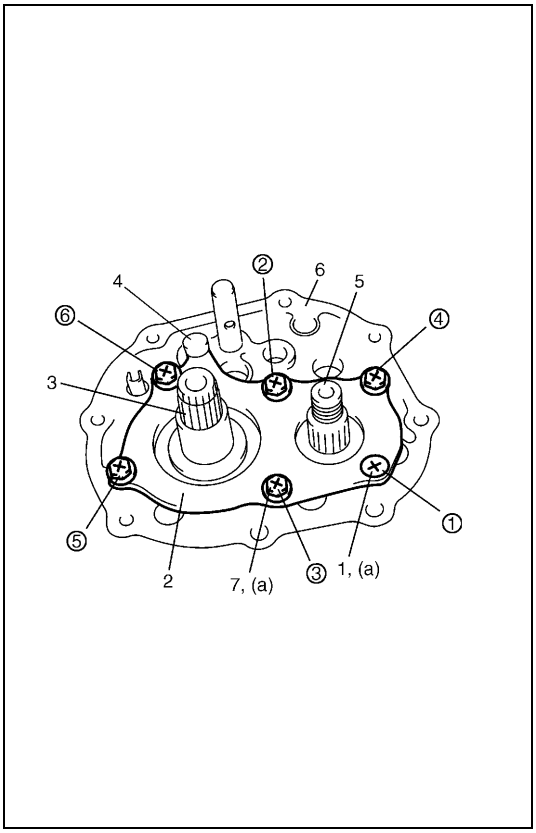
Available shim thickness
0.40, 0.45, 0.50, 0.55, 0.6, 0.65,0.7, 0.75, 0.8, 0.85, 0.9, 0.95, 1.0,1.05, 1.1 and 1.15 mm (0.015, 0.017, 0.019, 0.021, 0.023,0.025, 0.027, 0.029, 0.031, 0.033,0.035, 0.037, 0.039, 0.041, 0.043 and 0.045 in.)



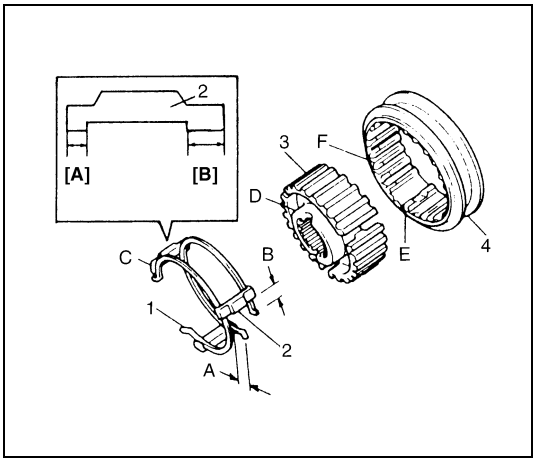
CAUTION:
Do not reuse left case plate screw (1) and bolts (7). Be sure to use new adhesive pre-coated screw and new adhesive pre-coated bolts. Otherwise, screw and/or bolts may loosen.

4) Place left case plate (2) inserting its end in groove of shift guide shaft (4) and tighten new adhesive pre-coated screw (1) and new adhesive per-coated bolts (7) temporarily with less than specified toque.
5) Tighten new screw(s) and new bolts to specified torque finally in the order of circled numbers (①→②→③→④→⑤→⑥) shown in figure.

NOTE:
After tightening screw and bolts, make sure that counter-shaft (5) can be rotated by hand feeling certain load.

Tightening torque
Left case plate screw and bolt
(a): 11 N·m (1.1 kg-m, 8.0 lb-ft)

3. Input shaft	6. Transaxle left case

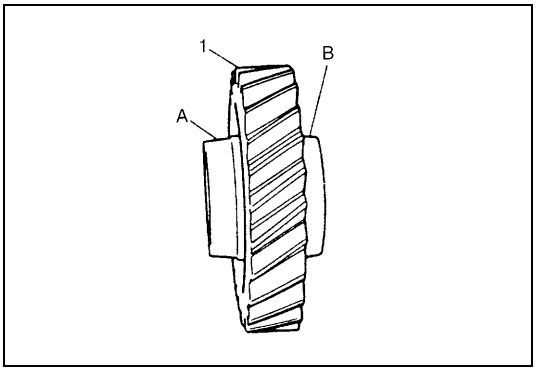


6) Assemble 5th speed synchronizer sleeve (4) and hub (3) with keys (2) and springs (1).

NOTE:
Short side C in keys, long flange D in hub and chamfered spline F in sleeve should face inward (5th gear side).

Synchronizer key installation position
: A = B

[A]: Short side C	D: Long flange (Inward)
[B]: Long side	E: Key way
C: Short side (Inward)	F: Chamfered spline (Inward)



7) Install 5th gear (1) to counter shaft facing machined boss A inward.

A: Machined boss (Inside)
B: No machining (Outside)

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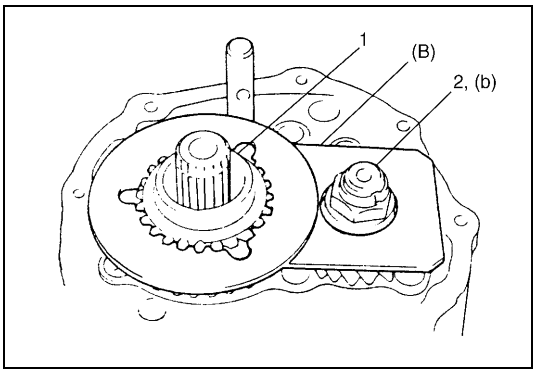
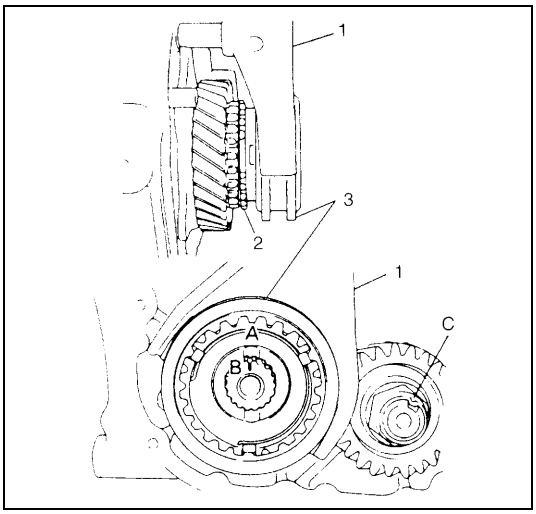


8) Install needle bearing of separated steel cage type to input shaft, apply oil then install 5th gear (1) and special tool to stop shaft rotation.

Special tool
(B): 09927-76010

9) Install new countershaft nut (2) and tighten it to specification.

Tightening torque
Countershaft nut (b): 60 N·m (6.0 kg-m, 43.5 lb-ft)

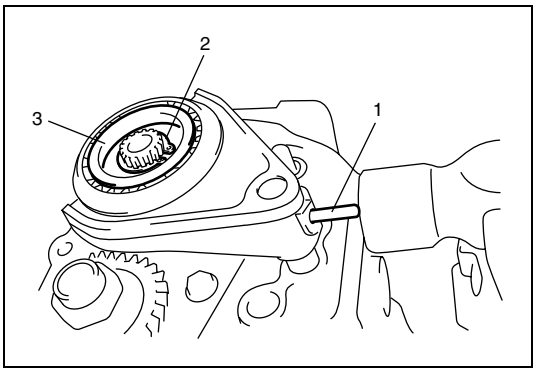


10) Remove special tool, then caulk nut at C with caulking tool and hammer.
11) Install synchronizer ring (2).
12) Fit 5th gear shift fork (1) to sleeve & hub assembly (3) and install them into input shaft, shift shaft and shift guide shaft at once aligning hub oil groove A with shaft mark B.

NOTE:

Long flange of hub faces inward (gear side).

A:	Oil groove (Align with B)
B:	Punch mark
C:	Caulking



13) Drive in spring pin (1).
14) Fit hub plate (3) and fix it with circlip (2).

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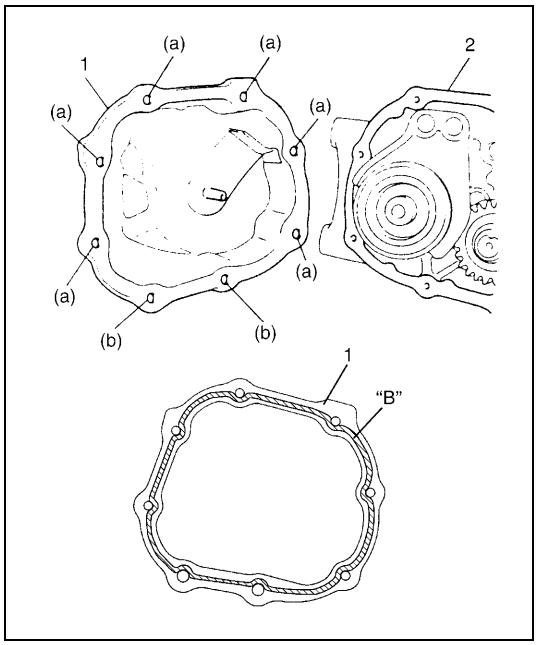

15) Clean mating surface of both left case (2) and side cover (1), apply sealant to side cover (1) by using a nozzle as shown in figure by such amount that its section is 1.5mm (0.059 in.) in diameter, mate it with left case and then tighten bolts.

"B": Sealant 99000-31260

Tightening torque
Side cover No.1 bolt (a): 10 N·m (1.0 kg-m, 7.5 lb-ft)
Side cover No.2 bolt (b): 23 N·m (2.3 kg-m, 17.0 lb-ft)

Tightening Torque Specification

Fastening part	Tightening torque		
	N•m	kg-m	lb-ft
Transmission oil level/filler and drain plugs	21	2.1	15.5
Oil gutter bolt	10	1.0	7.5
Final gear bolt	90	9.0	65.0
Reverse gear shift lever bolt	23	2.3	17.0
Transmission case bolt	19	1.9	14.0
Reverse shaft bolt	23	2.3	17.0
Locating spring bolt	13	1.3	9.5
Left case plate screw and bolt	11	1.1	8.0
Countershaft nut	60	6.0	43.5
Side cover No.1 bolt	10	1.0	7.5
Side cover No.2 bolt	23	2.3	17.0
Guide case bolt	23	2.3	17.0
Gear shift interlock bolt	23	2.3	17.0
5th to reverse interlock guide bolt	23	2.3	17.0
Backup lamp switch	19	1.9	14.0
Transaxle to engine bolt	85	8.5	64.0
Transaxle to engine nut	85	8.5	64.0
Engine left mounting bracket bolt	55	5.5	42.0
Engine rear mounting bolt	75	7.5	57.0
Engine rear mounting No.2 bracket bolt	55	5.5	42.0
Transaxle to engine rear mounting No.2 bracket bolt	55	5.5	42.0
Stiffener bolt	55	5.5	42.0
Clutch housing lower plate bolt	10	1.0	7.5
VSS bolt	5.5	0.55	4.0
Side cover No.1 bolt	10	1.0	7.5

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Fastening part	Tightening torque		
	N•m	kg-m	lb-ft
Side cover No.2 bolt	23	2.3	17.0
Gear shift guide case bolt	23	2.3	17.0
Select lever bracket bolt	23	2.3	17.0
Gear shift locating bolt	13	1.3	9.5
Gear shift control lever assembly	13	1.3	9.5
Cable mounting bolt	5.5	0.55	4.0
Cable bracket bolt	50	5.0	36.5

Required Service Material

Material	Recommended SUZUKI product (Part Number)	Use
Lithium grease	SUZUKI SUPER GREASE A (99000-25010)	• Oil seal lips • O-rings • Select lever boss • Select lever shaft bush • Gear shift control cable end
Sealant	SUZUKI BOND NO. 1217G (99000-31260)	• Oil drain plug and filler/level plug • Mating surface of transmission case • Mating surface of side cover • Gear shift interlock bolt • 5th to reverse interlock guide bolt • Gear shift guide case bolt • Gear shift locating bolt
Thread lock cement	THREAD LOCK 1322 (99000-32110)	• Reverse gear shift lever bolts • Oil gutter bolt • Reverse shaft bolt • Final gear bolts

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SECTION 7A1

MANUAL TRANSAXLE (M15 ENGINE)

WARNING:

For vehicles equipped with a Supplemental Restraint (Air Bag) System:

- **Service on and around the air bag system components or wiring must be performed only by an authorized SUZUKI dealer. Refer to "Air Bag System Components and Wiring Location View" under "General Description" in air bag system section in order to confirm whether you are performing service on or near the air bag system components or wiring. Please observe all WARNINGS and "Service Precautions" under "On-Vehicle Service" in air bag system section before performing service on or around the air bag system components or wiring. Failure to follow WARNINGS could result in unintentional activation of the system or could render the system inoperative. Either of these two conditions may result in severe injury.**
- **Technical service work must be started at least 90 seconds after the ignition switch is turned to the "LOCK" position and the negative cable is disconnected from the battery. Otherwise, the system may be activated by reserve energy in the Sensing and Diagnostic Module (SDM).**

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General Description

Manual Transaxle Construction and Servicing

The transaxle provides five forward speeds and one reverse speed by means of three synchromesh and three shafts-input shaft, counter shaft and reverse gear shaft. All forward gears are in constant mesh, and reverse uses a sliding idler gear arrangement.

The low speed sleeve & hub is mounted on counter shaft and engaged with counter shaft 1st gear or 2nd gear, while the high speed sleeve & hub is done on input shaft and engaged with input shaft 3rd gear or 4th gear.

The 5th speed sleeve & hub on input shaft is engaged with input shaft 5th gear mounted on the input shaft.

To prevent the cracking noise from the reverse gear when shifting transaxle gear into the reverse gear, the reverse shift braking device is used.

The device utilizes the 5th synchromesh, which is the lever synchro type, to apply the brake on the input shaft rotation.

The double cone synchronizing mechanism is provided to 2nd gear synchromesh device for high performance of shifting to 2nd gear.

The counter shaft turns the final gear and differential assembly, thereby turning the front drive shafts which are attached to the front wheels.

For servicing, it is necessary to use genuine sealant or its equivalent on mating surfaces of transaxle case which is made of aluminum. The case fastening bolts must be tightened to specified torque by means of torque wrench. It is also important that all parts are thoroughly cleaned with cleaning fluid and air dried before reassembling.

Further, care must be taken to adjust preload of counter shaft taper roller bearings. New synchronizer rings are prohibited from being lapped with respective gear cones by using lapping compound before they are assembled.

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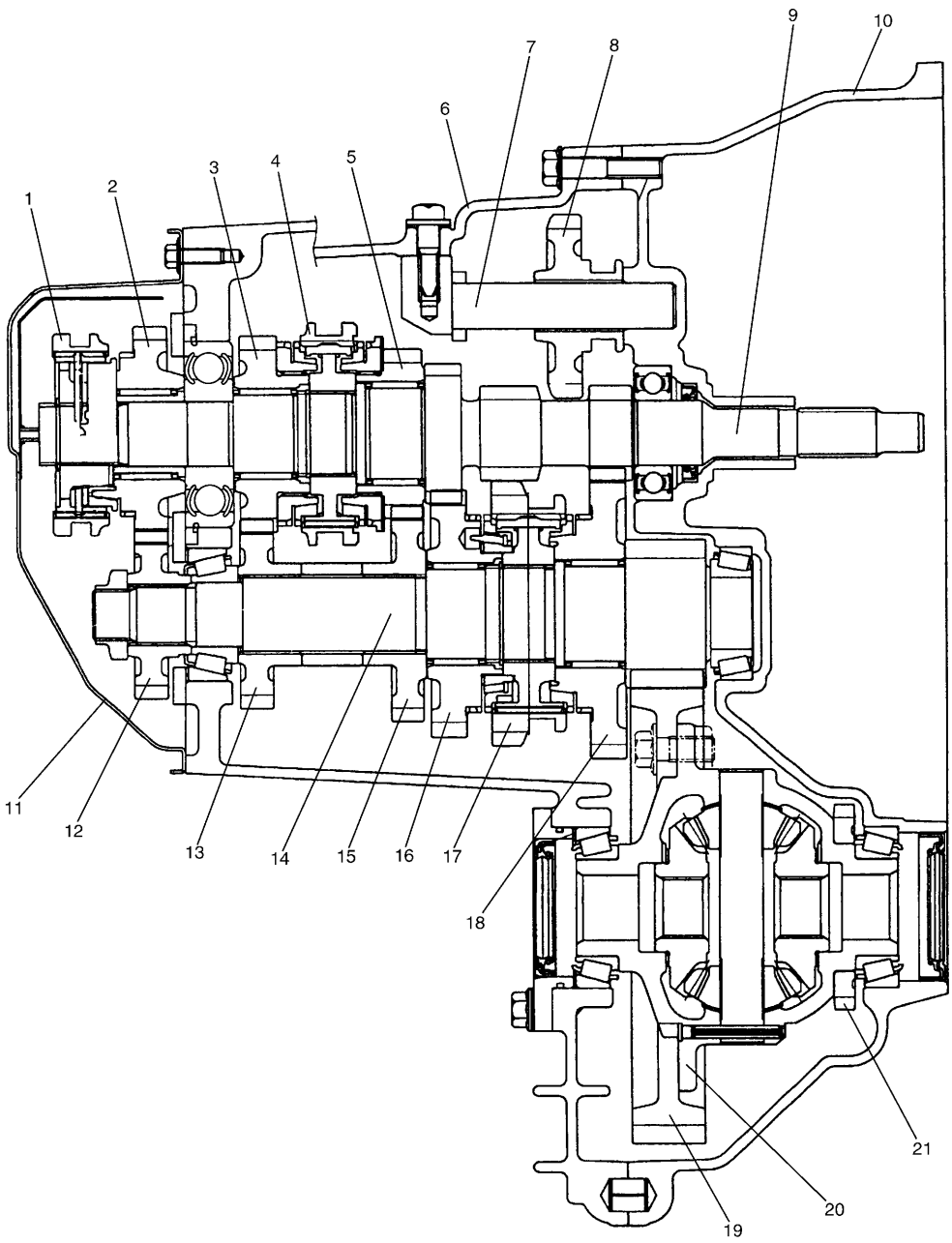
Transaxle Construction Diagram



1. 5th speed sleeve & hub	8. Reverse idler gear	15. counter shaft 3rd gear
2. Input shaft 5th gear	9. Input shaft	16. counter shaft 2nd gear
3. Input shaft 4th gear	10. Right case	17. Low speed sleeve & hub
4. High speed sleeve & hub	11. Side cover	18. counter shaft 1st gear
5. Input shaft 3rd gear	12. counter shaft 5th gear	19. Final gear
6. Left case	13. counter shaft 4th gear	20. Differential case
7. Reverse gear shaft	14. counter shaft	21. Vehicle speed sensor rotor

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Diagnosis

Manual Transaxle Symptom Diagnosis

Condition	Possible Cause	Correction
Gears slipping out of mesh	Maladjusted gear shift/select control cables	Adjust.
	Worn shift fork shaft	Replace.
	Worn shift fork or synchronizer sleeve	Replace.
	Weak or damaged locating springs	Replace.
	Worn bearings on input shaft or counter shaft	Replace.
	Worn chamfered tooth on sleeve and gear	Replace sleeve and gear.
Hard shifting	Maladjusted gear shift/select control cables	Adjust.
	Inadequate or insufficient lubricant	Replenish.
	Improper clutch pedal free travel	Adjust.
	Distorted or broken clutch disc	Replace.
	Damaged clutch pressure plate	Replace clutch cover.
	Worn synchronizer ring	Replace.
	Worn chamfered tooth on sleeve or gear	Replace sleeve or gear.
	Worn gear shift/select control cables joint	Replace.
	Distorted shift shaft	Replace.
Noise	Inadequate or insufficient lubricant	Replenish.
	Damaged or worn bearing(s)	Replace.
	Damaged or worn gear(s)	Replace.
	Damaged or worn synchronizer parts	Replace.

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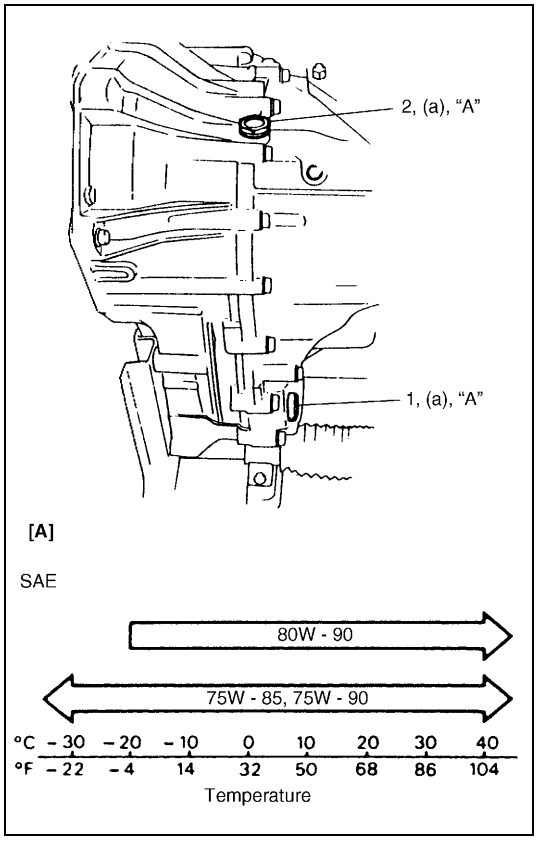
On-Vehicle Service

CAUTION:
Do not reuse circlip, spring pin, E-ring, oil seal, gasket, self locking nut and specified parts. Reuse of it can result in trouble.

Manual Transaxle Oil Change

1) Before changing or inspecting oil, be sure to stop engine and lift vehicle horizontally.
2) With vehicle lifted up, check oil level and leakage.
   If leakage exists, correct it.
3) Drain old oil and fill new specified oil by specified amount (up to level hole).
4) Apply sealant to thread of drain plug (1) and level/filler plug (2) and torque them as specified below.



"A": Sealant 99000-31260

Tightening torque
Transaxle oil level/filler and drain plugs
(a): 21 N·m (2.1 kg-m, 15.5 lb-ft)

NOTE:

- **It is highly recommended to use API GL-4 75W-90 gear oil.**
- **Whenever vehicle is hoisted for any other service work than oil change, also be sure to check for oil leakage.**

Transaxle oil
: API GL-4
For SAE classification, refer to viscosity chart [A] in the figure.

Transaxle oil capacity
: 2.2 liters (4.8/3.9 US/Imp. pt.)

Differential Side Oil Seal Replacement

Replacement

1) Lift up vehicle and drain transaxle oil.
2) Remove front drive shafts referring to "Drive Shaft Assembly" in Section 4A.

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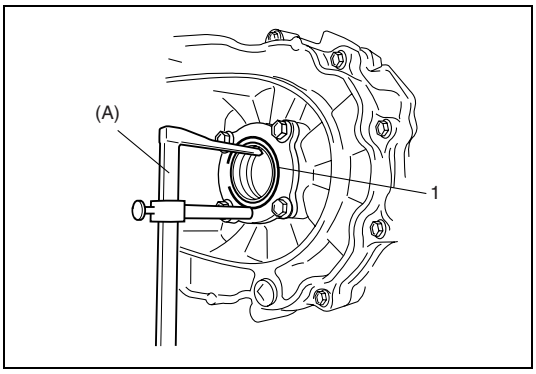
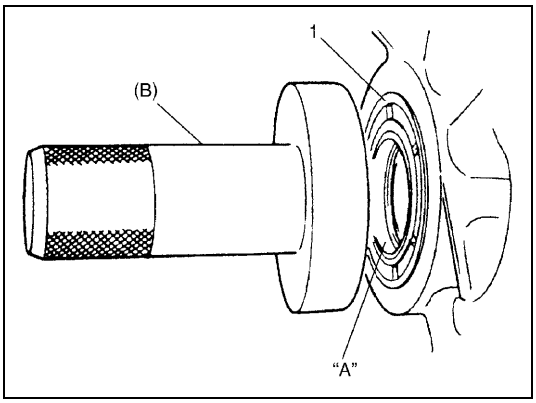


3) Remove oil seal (1) using special tool.

Special tool
(A): 09913-50121



4) Install oil seal (1) facing its spring side upward.
   Use special tool and hammer for installation.

Special tool
(B): 09913-85210

5) Apply grease to oil seal lip and at the same time check drive shaft where oil seal (1) contacts and make sure of its smoothness.

"A": Grease 99000-25010

6) Insert front drive shafts referring to "Drive Shaft Assembly" in Section 4A.
7) Install ball stud and stabilizer mount brackets referring to "Wheel Hub and Steering Knuckle" and "Stabilizer Bar and/or Bushings" in Section 3D.
8) Install tie-rod end referring to "Tie-Rod End" in Section 3B.
9) Fill transaxle oil as specified referring to "Manual Transaxle Oil Change" in this section, and make sure that oil has been sealed with oil seal.

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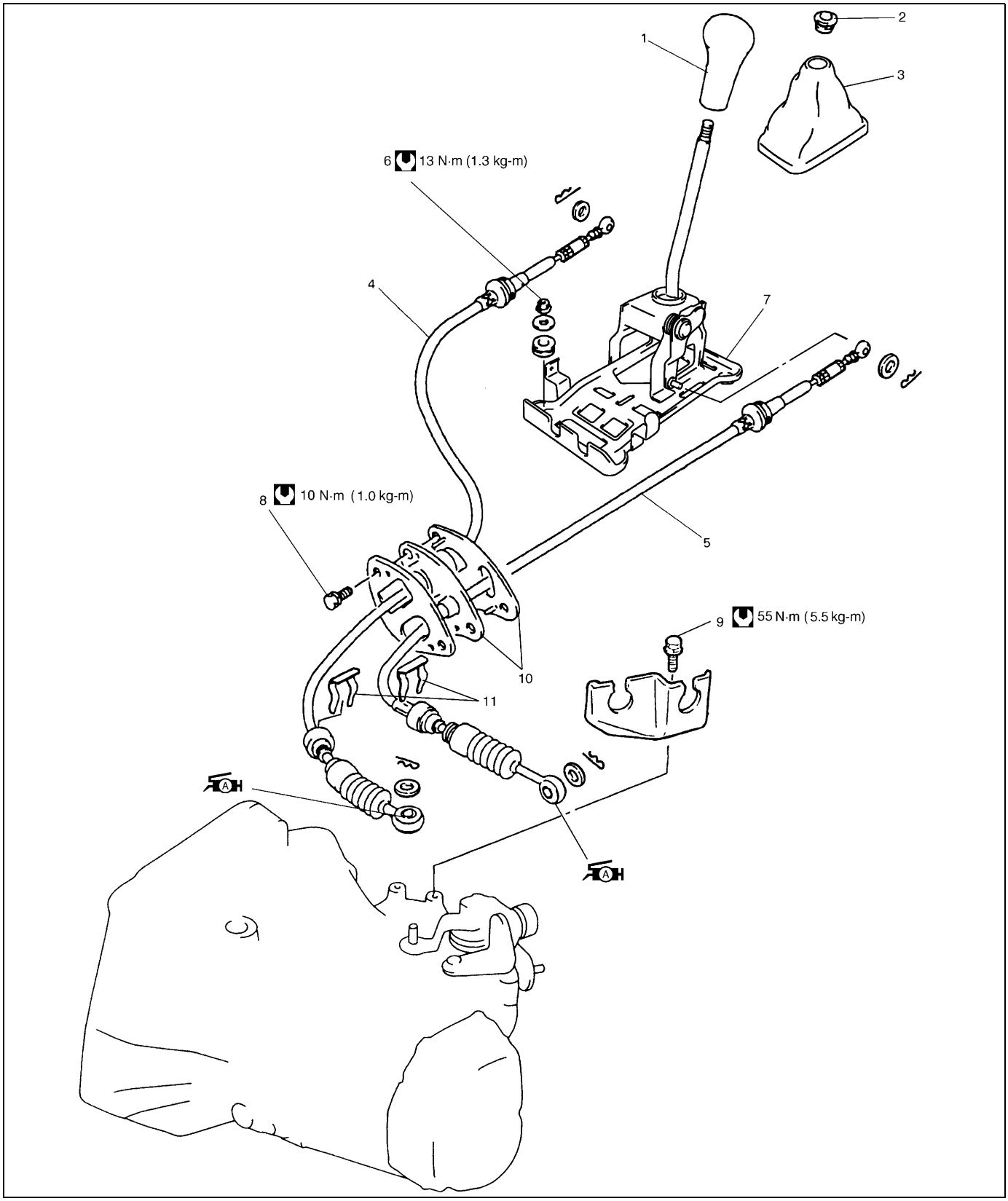
Gear Shift Control Lever and Cable Components



1. Gear shift control lever knob	5. Gear select control cable : Apply grease 99000-25010 to connecting portion of gear select control cable.	9. Cable bracket bolt
2. Lever boot holder	6. Gear shift control lever assembly mounting nut	10. Cable grommet
3. Gear shift lever boot	7. Gear shift control lever assembly	11. E-ring
A H 4. Gear shift control cable : Apply grease 99000-25010 to connecting portion of gear shift control cable.	8. Cable mounting bolt	Tightening torque

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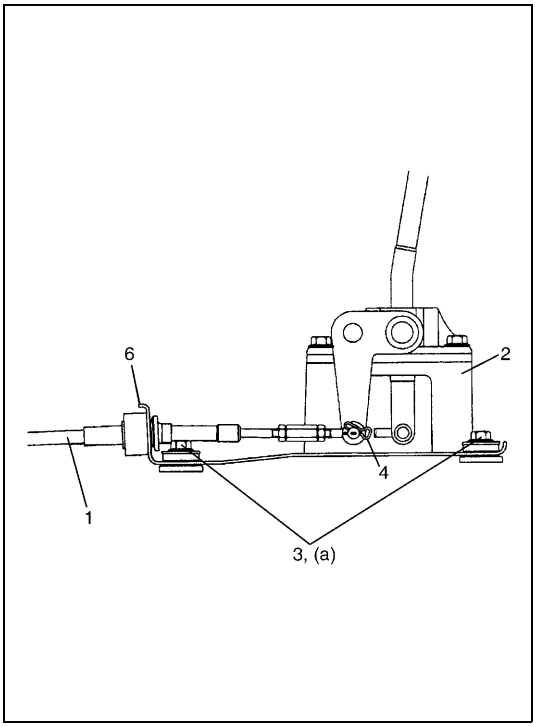
Gear Shift Control Lever and Cable Removal and Installation

Removal

1) Remove console box.



2) Disconnect gear shift and select control cables (1) from gear shift control lever assembly (2).
   a) Remove clip (4) and then disconnect cable end.
   b) Detach cable from bracket (6).
3) Remove gear shift control lever assembly mounting nuts (3) and gear shift lever assembly (2) from body.
4) Disconnect shift and select cables (1) from transaxle in the same manner as step 2).
5) Remove cable grommet and cable clamp, and then remove shift and select cables (1) from body.

Installation

Reverse removal procedure for installation noting the following.

- Tighten gear shift control lever assembly mounting nuts (3) to specified torque.

Tightening torque
Gear shift control lever assembly mounting nut
(a): 13 N·m (1.3 kg-m, 9.5 lb-ft)

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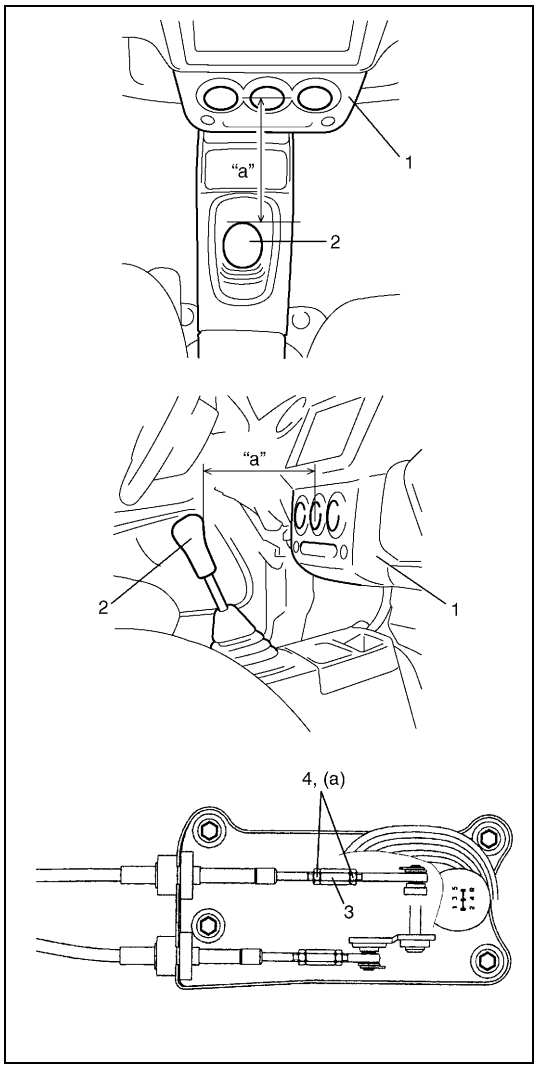
Gear Shift Control Lever and Cable Adjustment



- Adjustment of shift cable:

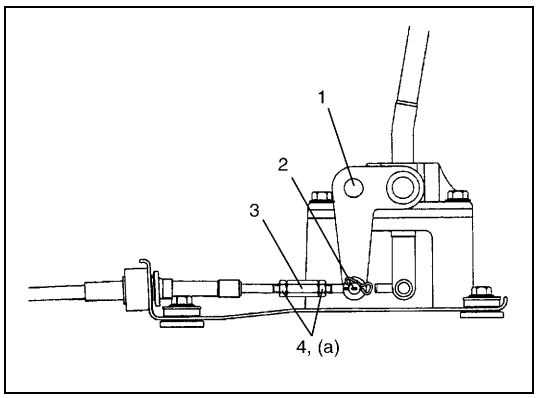
a) With shift control lever in "NEUTRAL" position, adjust shift cable adjusting nut (3) so that distance "a" between edge of instrument panel (1) and center of shift knob (2) measured as specified value.

Distance "a": 121 – 131 mm (4.76 – 5.16 in.)

b) After shift cable adjustment, tighten cable lock nut (4) to specified torque.

Tightening torque
Cable lock nut (a): 5.5 N·m (0.55 kg-m, 4.0 lb-ft)

c) Make sure that boots are installed correctly.



- Adjustment of select cable:

a) With shift control lever in "NEUTRAL" position, adjust select cable adjusting nut (3) so that gear select arm shaft (1) and cable end (2) are aligned vertically as shown.

b) After select cable adjustment, tighten cable lock nut (4) to specified torque.

Tightening torque
Cable lock nut (a): 5.5 N·m (0.55 kg-m, 4.0 lb-ft)

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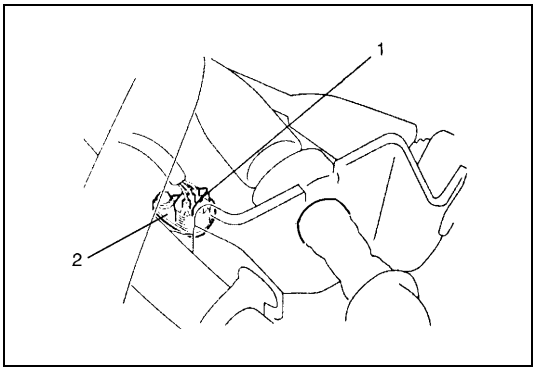
Vehicle Speed Sensor (VSS) Removal and Installation

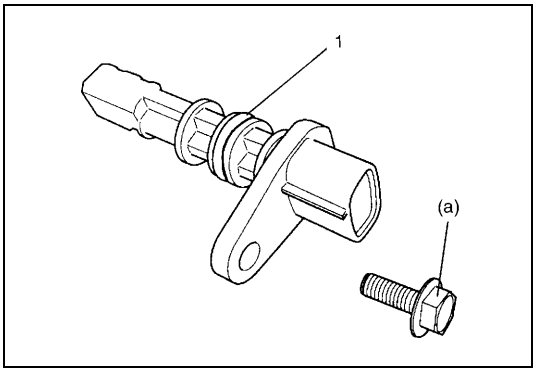
Removal

1) Disconnect negative cable at battery.



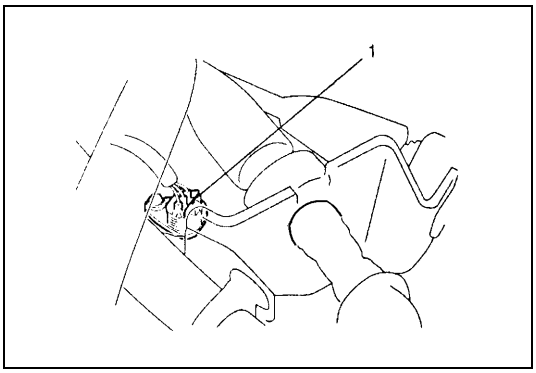
2) Disconnect VSS coupler (1).
3) Remove VSS (2).

Installation



1) Apply oil to new O-ring (1) and then install VSS to transaxle.

Tightening torque
VSS bolt (a): 5.5 N·m (0.55 kg-m, 4.0 lb-ft)



2) Connect VSS coupler (1).
3) Connect negative cable at battery.

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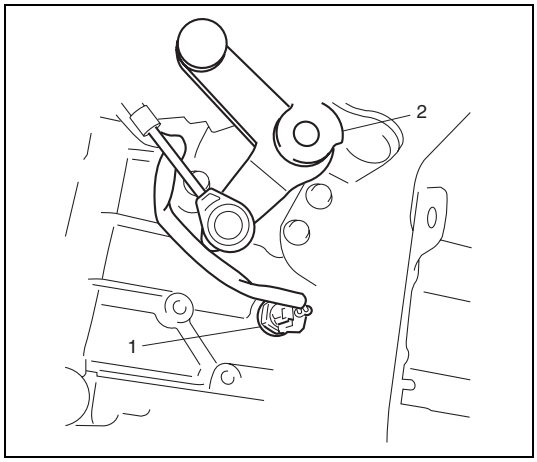
Back Up Lamp Switch Removal and Installation

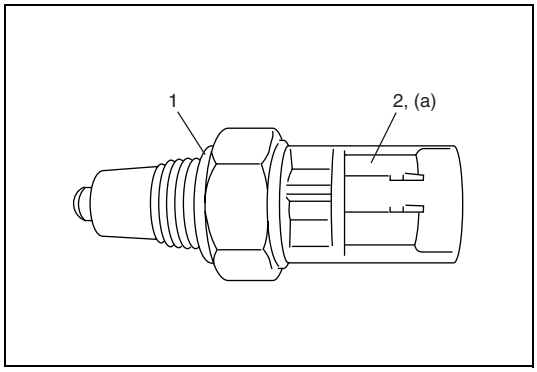
Removal



1) Disconnect negative cable at battery.
2) Disconnect back up lamp switch coupler (1).
3) Remove back up lamp switch.

2. Gear shift and select shaft assembly

Installation

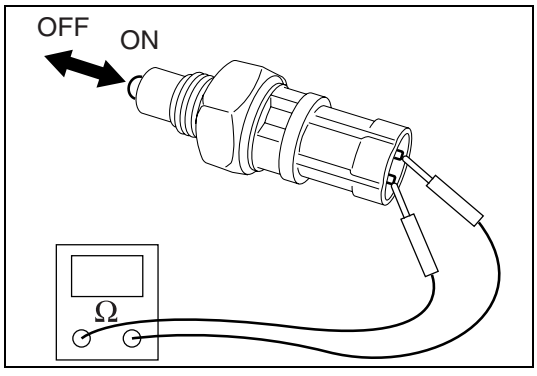


1) Apply oil to new O-ring (1) and tighten back up lamp switch (2) to specified torque.

Tightening torque
Back up lamp switch (a): 23 N·m (2.3 kg-m, 17.0 lb-ft)

2) Connect back up lamp switch coupler.
3) Connect negative cable at battery.

Back Up Lamp Switch Inspection



Check back up lamp switch for function using ohmmeter.

Switch ON: Continuity
Switch OFF: No continuity

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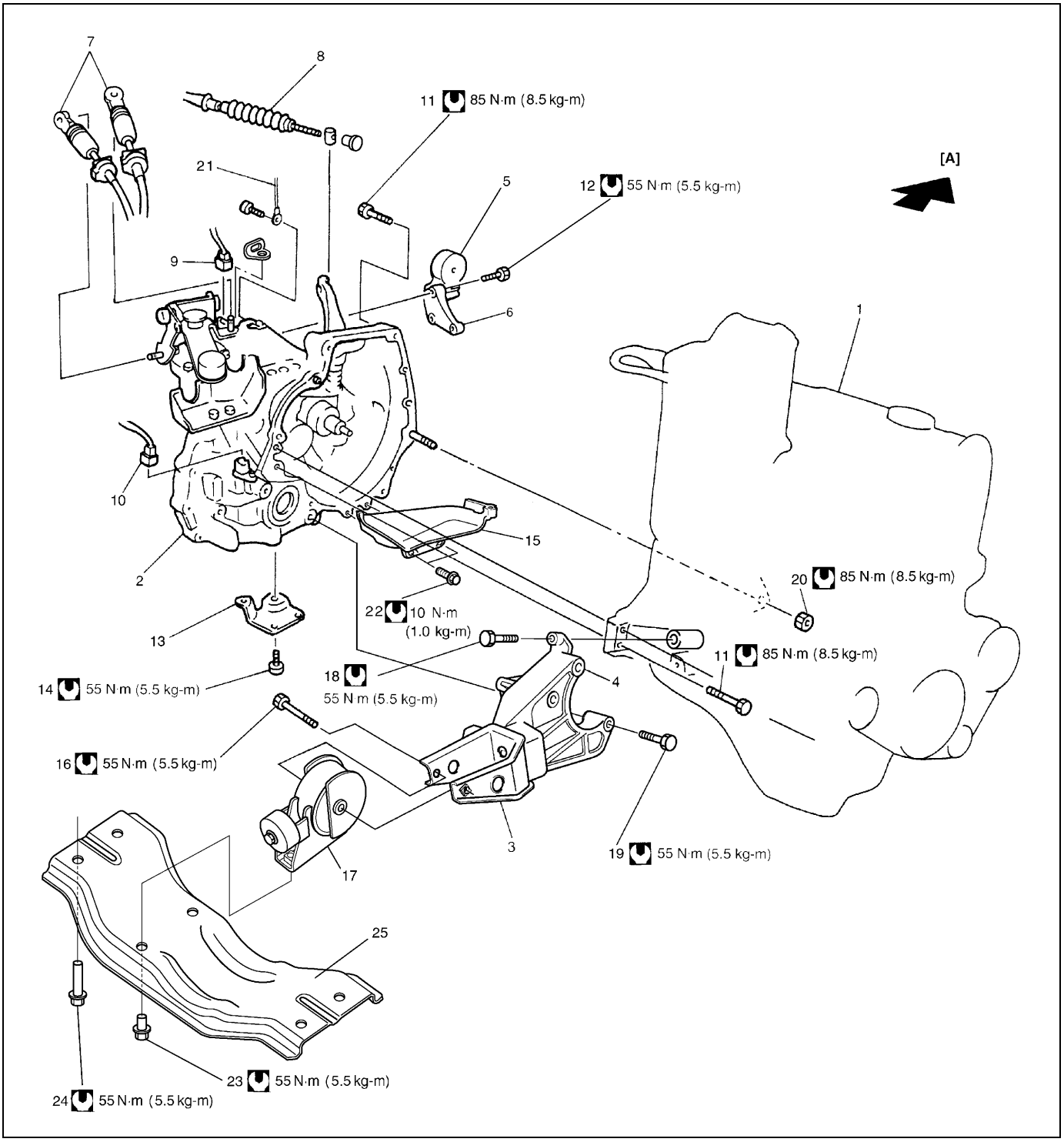
Unit Repair Overhaul

Transaxle Unit Components



[A]: Forward	9. Back up lamp switch connector	18. Engine rear mounting No.2 bracket bolts
1. Engine	10. VSS connector	19. Transaxle to engine rear mounting No.2 bracket bolt
2. Transaxle	11. Transaxle to engine bolts	20. Transaxle to engine nut
3. Engine rear mounting No.1 bracket	12. Engine left mounting bracket bolt	21. Ground cable
4. Engine rear mounting No.2 bracket	13. Engine rear mounting bracket stiffener	22. Clutch housing lower plate bolts
5. Engine left mounting	14. Stiffener bolts	23. Engine rear mounting No.2 bolt
6. Engine left mounting bracket	15. Clutch housing lower plate	24. Rear mounting member bolt
7. Shift & select control cables	16. Engine rear mounting No.1 bolt	25. Rear mounting member
8. Clutch cable	17. Engine rear mounting	Tightening torque

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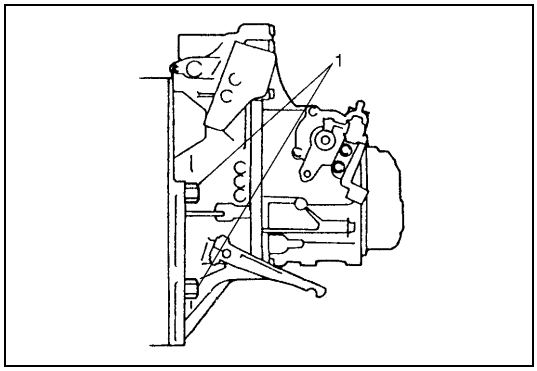
Transaxle Unit Dismounting and Remounting

Dismounting

Under hood

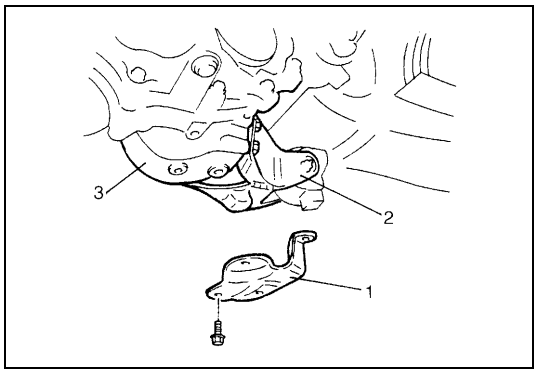
1) Remove battery and tray.
2) Undo wiring harness clamps, disconnect backup lamp switch coupler, VSS coupler and ground cable.
3) Disconnect clutch cable from clutch release lever and bracket.
4) Disconnect gear shift and select control cables.
5) Remove transaxle control cable bracket.
6) Remove water pipe bracket bolts from transaxle.



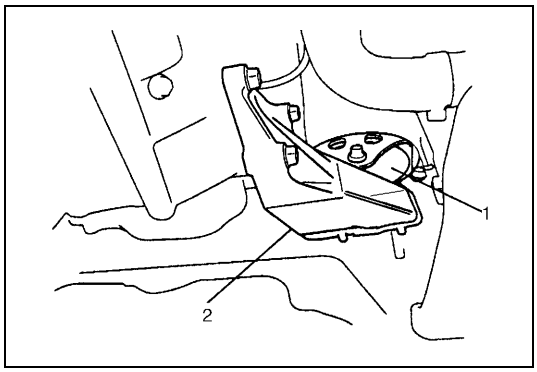
7) Remove transaxle to engine bolts (1).
8) Support engine by using lifting device.

On lift

9) Drain transaxle oil referring to “Manual Transaxle Oil Change” in this section.
10) Remove left and right front drive shaft and center shaft referring to “Drive Shaft Assembly” in Section 4A.
11) Remove left side of engine under cover.
12) Remove starting motor referring to “On-Vehicle Service” in Section 6G.



13) Remove engine rear mounting bracket stiffener (1).
14) Remove clutch housing lower plate.
15) Remove engine rear mounting member.
16) Remove engine rear mounting No.1 bracket (2) with No.2 bracket (3).
17) Remove transaxle to engine bolts and nut.
18) Lower vehicle and support transaxle with transaxle jack.



19) Remove engine left mounting (1) with bracket (2).
20) Remove other attached parts from transaxle, if any.
21) Pull transaxle out so as to disconnect input shaft from clutch disc and then lower it.

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Remounting

CAUTION:
Care should be taken not to scratch oil seal lip with drive shaft while raising transaxle.
Do not hit drive shaft joint with hammer when installing it into differential gear.

Reverse dismounting procedure for remounting noting the following.

- Refer to “Transaxle Unit Components” for fastener specified torque.
- Push in drive shaft joints (right & left) and center shaft referring to “Drive Shaft Assembly” in Section 4A.
- Set each clamp for wiring securely.
- Install starting motor referring to “On-Vehicle Service” in Section 6G.
- After connecting clutch cable, be sure to adjust its play properly.
  Refer to “On-Vehicle Service” in Section 7A.
- Fill transaxle with oil as specified referring to “Manual Transaxle Oil Change” in this section.
- Connect battery and check function of engine, clutch and transaxle.

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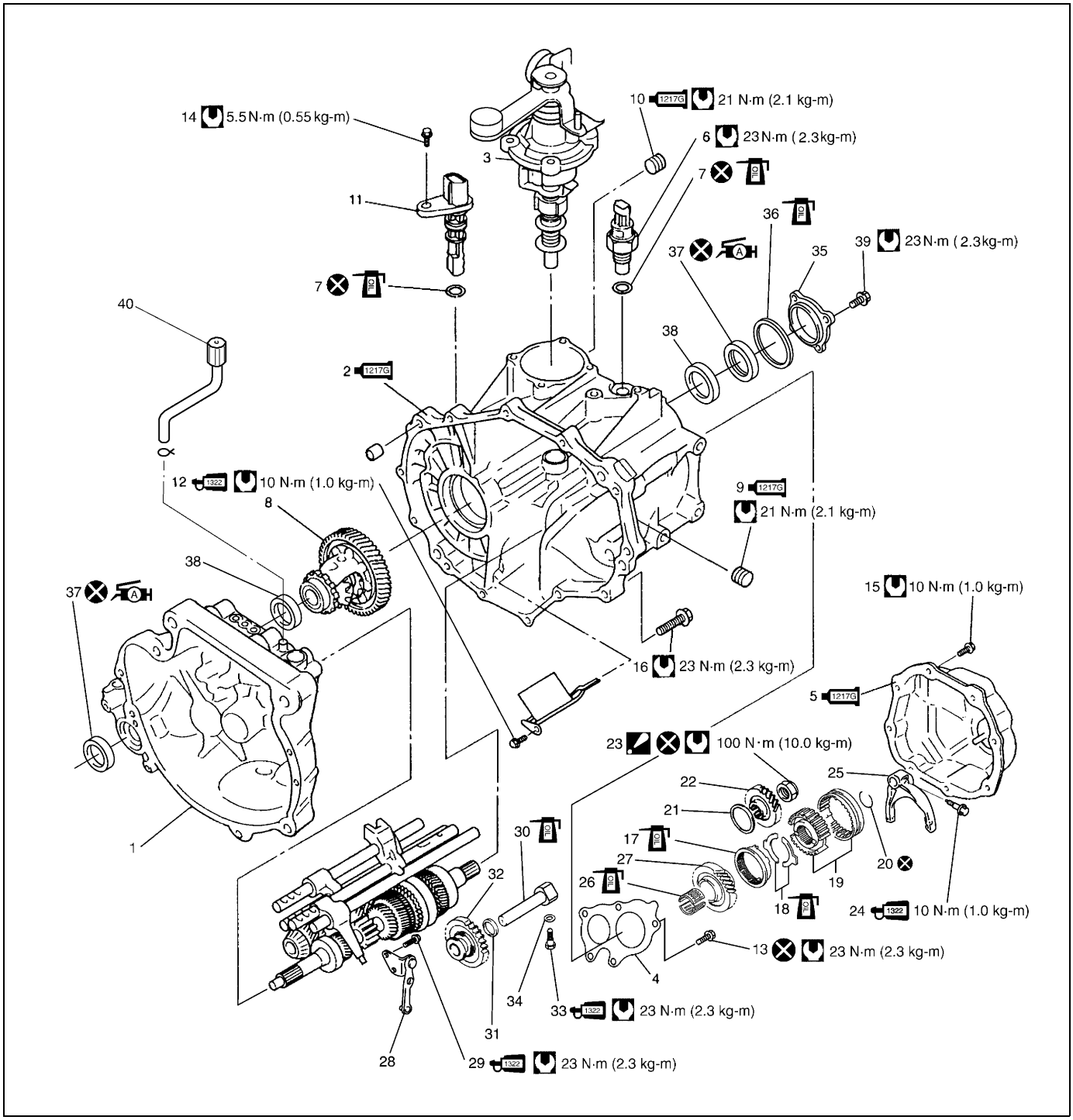
Transaxle Case Components



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	1. Transaxle right case		23. Counter shaft nut : After tightening nut to specified torque, caulk nut securely.
1217G	2. Transaxle left case : Apply sealant 99000-31260 to mating surface of left case and right case.	1322	24. Shift fork bolt : Apply thread lock 99000-32110 to all around thread part of bolt.
	3. Gear shift and select shaft assembly		25. 5th gear shift fork
	4. Transaxle left case plate		26. Needle bearing (Separated steel cage type.)
1217G	5. Transaxle side cover : Apply sealant 99000-31260 to mating surface of side cover and left case.		27. Input shaft 5th gear
	6. Back up lamp switch		28. Reverse gear shift lever
	7. O-ring	1322	29. Reverse gear shift lever bolt : Apply thread lock 99000-32110 to all around thread part of bolt.
	8. Differential assembly		30. Reverse gear shaft
1217G	9. Oil level/filler plug : Apply sealant 99000-31260 to all around thread part of plug.		31. Washer
1217G	10. Oil drain plug : Apply sealant 99000-31260 to all around thread part of plug.		32. Reverse idler gear
	11. VSS	1322	33. Reverse shaft bolt : Apply thread lock 99000-32110 to all around thread part of bolt.
1322	12. Oil gutter bolt : Apply thread lock 99000-32110 to all around thread part of bolt.		34. Washer
	13. Left case plate bolts		35. Side bearing retainer
	14. VSS bolt		36. O-ring
	15. Side cover bolts	A	37. Oil seal : Apply SUZUKI SUPER GREASE A 99000-25010 to Oil seal lip.
	16. Transaxle case bolts		38. Outer race
	17. 5th speed synchronizer ring		39. Side bearing retainer bolt
	18. 5th speed synchronizer lever		40. Breather hose
	19. 5th speed sleeve & hub		Tightening torque
	20. Circlip		Do not reuse.
	21. Bearing set shim		Apply transaxle oil.
	22. Counter shaft 5th gear		

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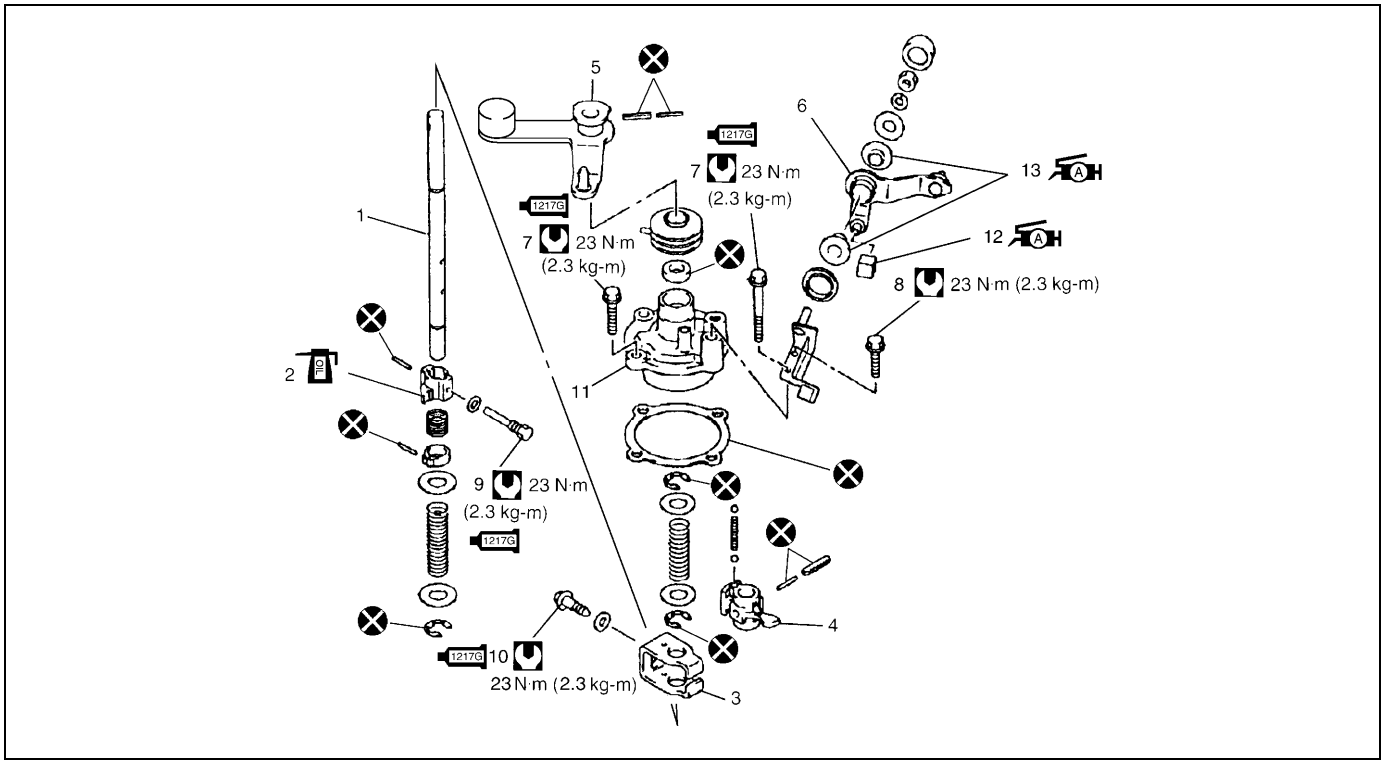
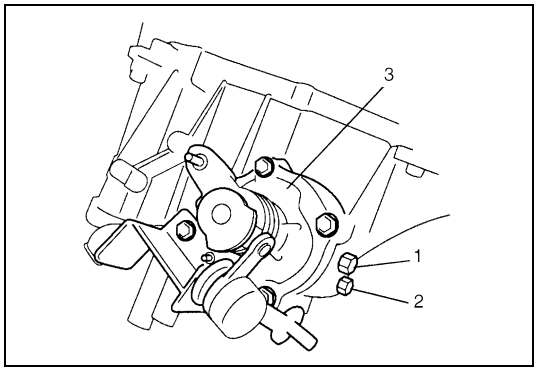
Gear Shift and Select Shaft Assembly Components



1. Gear shift & select shaft	1217G	7. Gear shift guide case bolt : Apply sealant 99000-31260 to bolt thread.	13. Select lever boss : Apply grease 99000-25010 to internal and external diameter
2. 5th & reverse gear shift cam		8. Select lever bracket bolt	Tightening torque
3. Gear shift interlock plate	1217G	9. 5th to reverse interlock guide bolt : Apply sealant 99000-31260 to bolt thread.	Do not reuse.
4. Gear shift & select lever	1217G	10. Gear shift interlock bolt : Apply sealant 99000-31260 to bolt thread.	Apply transaxle oil.
5. Shift cable lever		11. Guide case	
6. Select cable lever		12. Select lever shaft bush : Apply grease 99000-25010 to whole area of bush.	

Gear Shift and Select Shaft Assembly Removal and Installation

Removal



1) Remove gear shift interlock bolt (1) and 5th to reverse interlock guide bolt (2) from transaxle case.
2) Remove gear shift and select shaft assembly (3).

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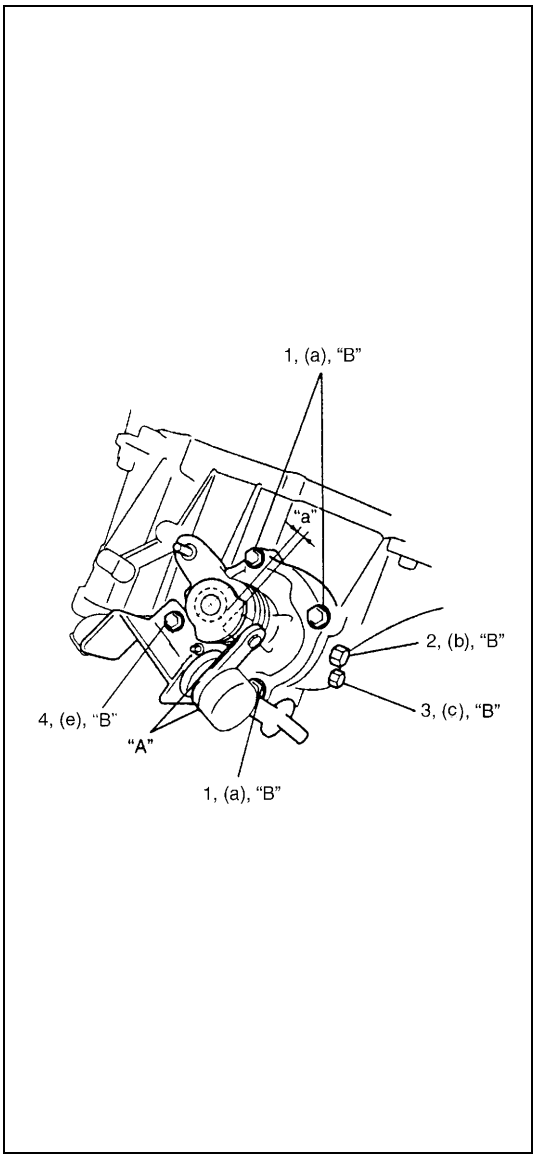

Installation

1) Apply grease to select lever shaft bush and select lever boss, and install gear shift and select shaft assembly with new gasket into transaxle.

"A": Grease 99000-25010

2) Apply sealant to gear shift guide case bolts (1) and select lever bracket bolt (4). Tighten gear shift guide case bolts (1) and select lever bracket bolt (4) to specified torque at the position that clearance "a" is within 1 – 1.5 mm (0.04 – 0.06 in.).

"B": Sealant 99000-31260

Tightening torque
Gear shift guide case bolt (a): 23 N·m (2.3 kg-m, 17.0 lb-ft)
Select lever bracket bolt (e): 23 N·m (2.3 kg-m, 17.0 lb-ft)

3) Install washer and gear shift interlock bolt (2) to which sealant have been applied, and then tighten it to specified torque.

"B": Sealant 99000-31260

Tightening torque
Gear shift interlock bolt (b): 23 N·m (2.3 kg-m, 17.0 lb-ft)

4) Install washer and 5th to reverse interlock guide bolt (3) to which sealant have been applied and then tighten it to specified torque.

"B": Sealant 99000-31260

Tightening torque
5th to reverse interlock guide bolt
(c): 23 N·m (2.3 kg-m, 17.0 lb-ft)

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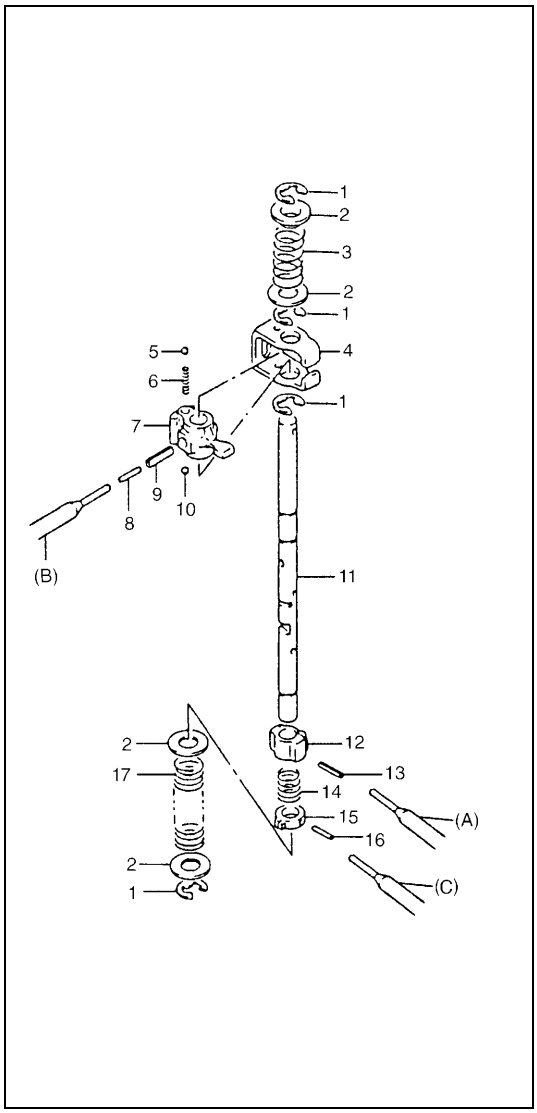
Gear Shift and Select Shaft Disassembly and Assembly



1) Push spring pins out using specified spring pin removers as shown bellow.

Special tool
(A): 09922-85811 (4.5 mm)
(B): 09925-78210 (6.0 mm)
(C): 2.8 – 3.0 mm (0.11 – 0.12 in.) Commercially available spring pin remover

2) Inspect component parts for wear, distortion or damage. If any detect is found, replace detective part with new one.

NOTE:

- **When driving in spring pins, prevent shaft from being bent by supporting it with wood block.**
- **Assemble 5th & reverse gear shift cam with its pit and spring pin aligned.**
- **Make sure to select an appropriate spring by identifying the painted colors to keep gear shifting performance as designed.**
  - **– Low speed select spring (17) - No paint**
  - **– Reverse select spring (3) - Pink**

1. E-ring	10. Ball
2. Washer	11. Gear shift & select shaft
3. Reverse select spring	12. 5th & reverse gear shift cam
4. Gear shift interlock plate	13. Spring pin
5. Ball	14. Cam guide return spring
6. Gear shift interlock spring	15. 5th & reverse gear shift cam guide
7. Gear shift & select lever	16. Spring pin
8. Spring pin	17. Low speed select spring
9. Spring pin	

Fifth Gear Disassembly and Assembly

Disassembly

1) Remove gear shift & select shaft assembly referring to “Gear Shift and Select Shaft Assembly Removal and Installation” in this section.
2) Remove 9 bolts and take off transaxle side cover.

CAUTION:
Care should be taken not to distort side cover when it is removed from left case.

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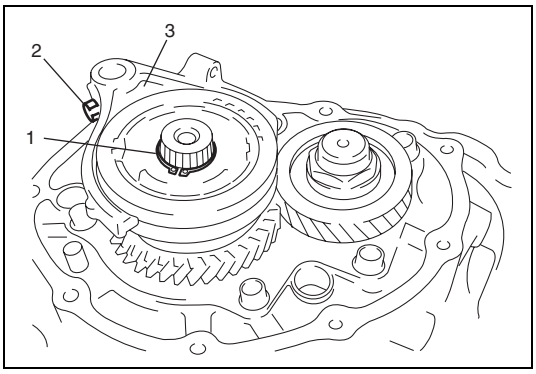
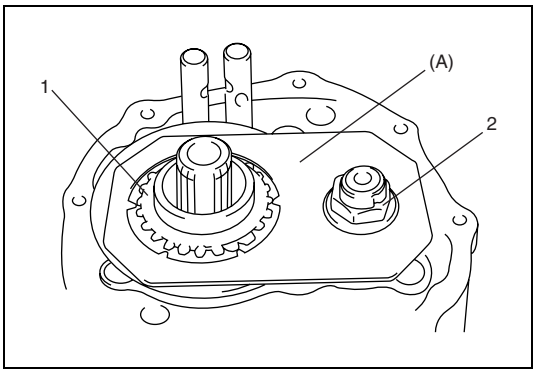


3) Using special tool, remove circlip (1).

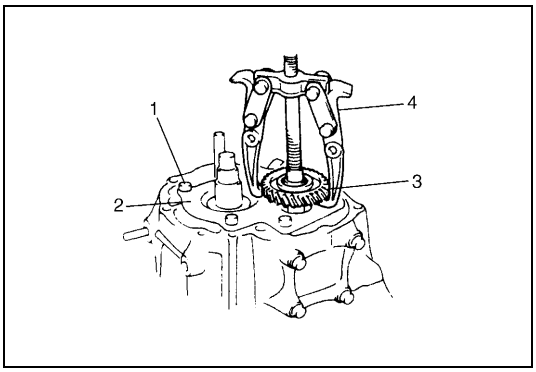
Special tool
09900-06107

4) Remove 5th shift fork bolt (2).
5) Remove gear shift fork (3), sleeve & hub assembly, synchronizer levers, synchronizer ring and 5th gear all together. Use gear puller for removal if spline fitting of hub is tight.



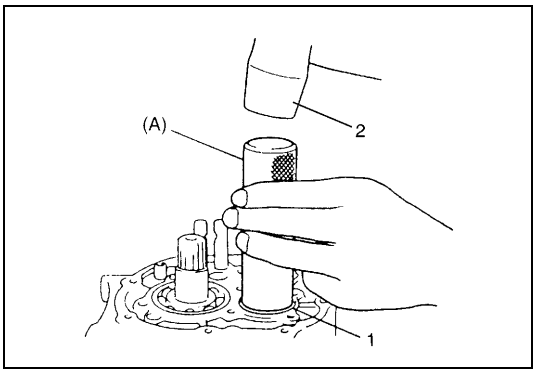
6) Unfasten caulking of counter shaft nut (2), install input shaft 5th gear (1) and special tool to stop rotation of shafts, and then remove counter shaft nut.

Special tool
(A): 09927-76060



7) Remove input shaft 5th gear, needle bearing and counter shaft 5th gear (3). Gear puller (4) would be necessary if spline fitting of counter shaft 5th gear is tight.
8) Remove bolts (1), and take off left case plate (2) and bearing set shim.

Assembly



1) Install counter shaft left bearing outer race (1) to bearing cone, and tap cup using special tool and plastic hammer (2).

Special tool
(A): 09913-70123

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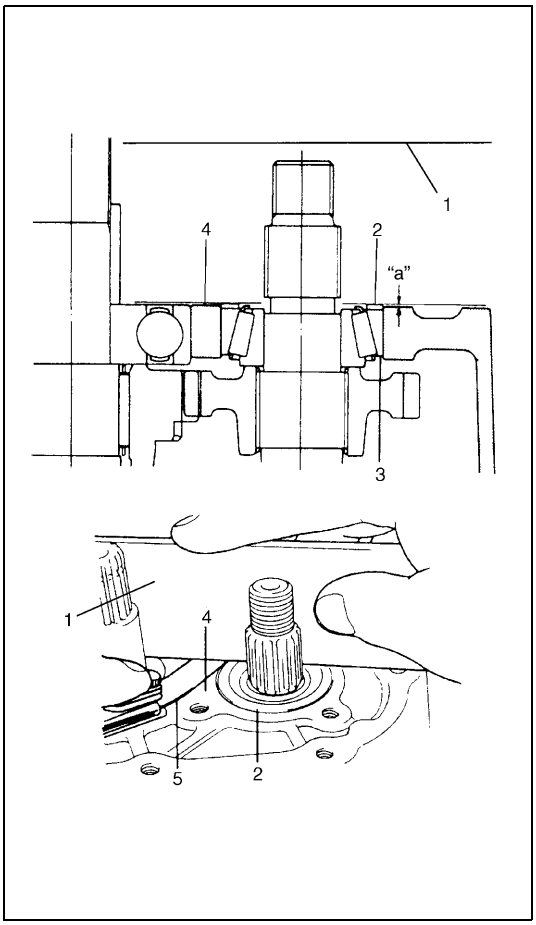


2) With putting a shim (2) on bearing outer race (3), place straight edge (1) over it and compress it by hand through straight edge, and then measure clearance "a" between case surface (4) and straight edge using feeler gauge (5).

Clearance between case surface and straight edge "a": 0.13 – 0.17 mm (0.0051 – 0.0067 in.) (Shim protrusion)

3) By repeating above step, select a suitable shim which adjusts clearance "a" to specification and put it on bearing outer race.

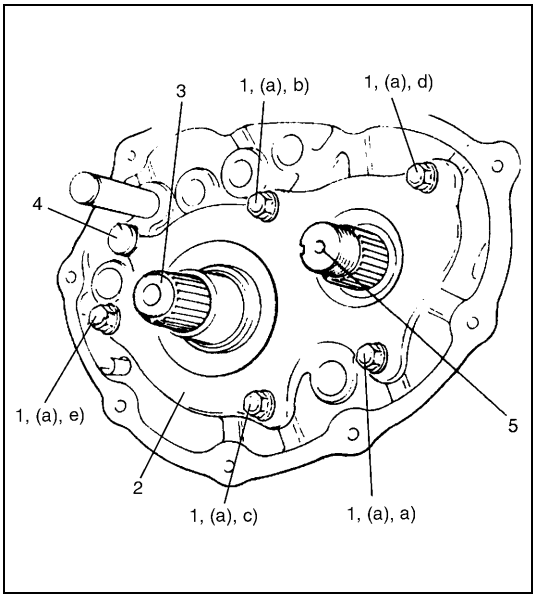
NOTE:

Insert 0.15 mm (0.0059 in.) feeler to know whether or not a shim fulfills specification quickly.

Available shim thickness
0.55, 0.6, 0.65,0.7, 0.75, 0.8, 0.85, 0.9, 0.95, 1.0, 1.05 and 1.10 mm (0.021, 0.023, 0.025, 0.027, 0.029, 0.031, 0.033, 0.035, 0.037, 0.039, 0.041 and 0.043 in.)

CAUTION:

Do not reuse left case plate bolts. Be sure to use new adhesive pre-coated bolts. Otherwise, bolts may loosen.



4) Place left case plate (2) inserting its end in groove of shift guide shaft (4) and tighten new adhesive pre-coated bolts (1) temporarily with less than specified torque.
5) Tighten new bolts to specified torque finally in the order of alphabets (a) →b) →c) →d) →e)) shown in figure.

NOTE:

After tightening bolts, make sure that counter shaft can be rotated by hand feeling certain load.

Tightening torque
Left case plate bolt
(a): 23 N·m (2.3 kg-m, 17.0 lb-ft)

3.	Input shaft
5.	Counter shaft

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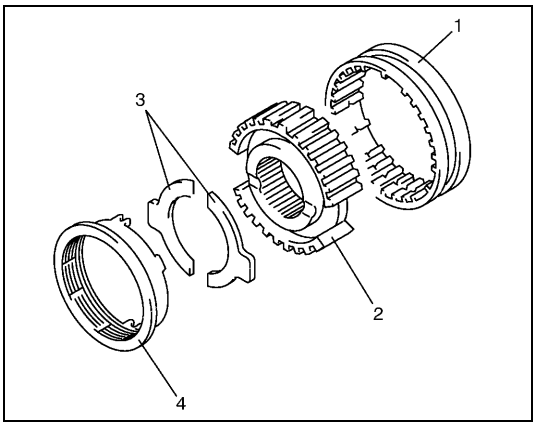
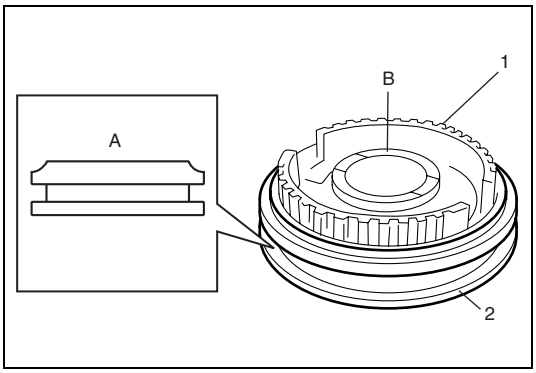
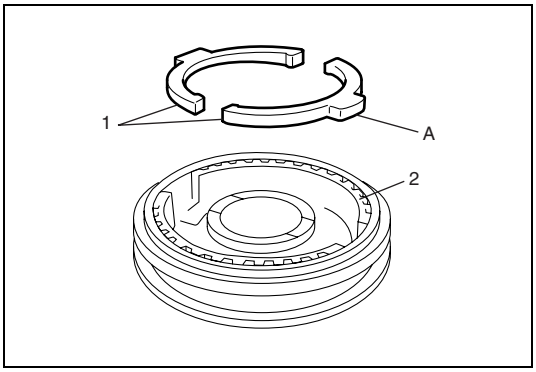


6) Assemble 5th speed synchronizer sleeve (1), hub (2), 5th speed synchronizer levers (3) and synchronizer ring (4) as follows.

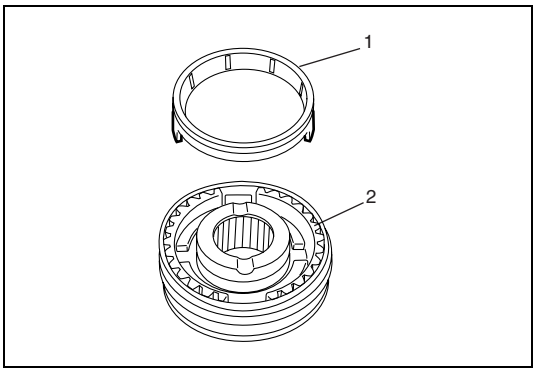


a) Install hub (1) to 5th speed synchronizer sleeve (2) in specified direction as shown in figure.

A: Chamfered side
B: Long boss



b) Fit 5th speed synchronizer levers (1) to hub (2) Aligning protrusion “A” of 5th speed synchronizer levers (1) with groove of hub (2).



c) Install synchronizer ring (1) to hub (2) as shown in figure.

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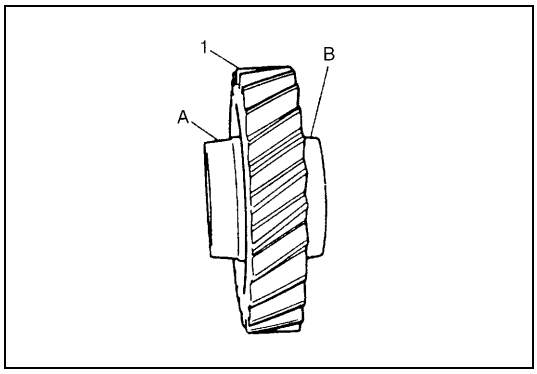
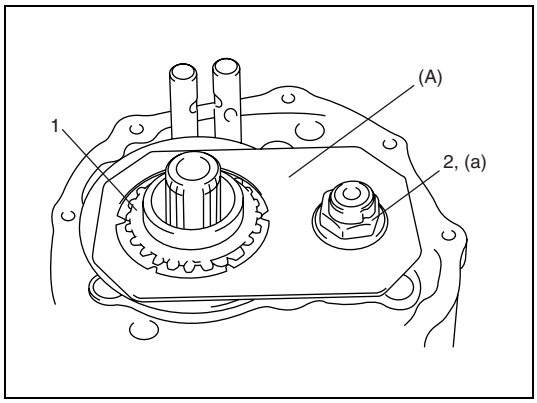


7) Install 5th gear (1) to counter shaft facing machined boss A inward.

A:	Machined boss (Inside)
B:	No machining (Outside)

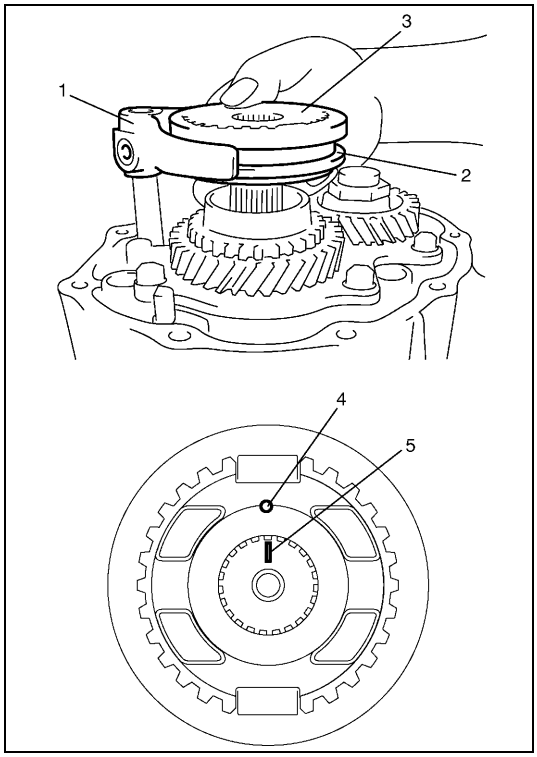


8) Install needle bearing of separated steel cage type to input shaft, apply oil then install 5th gear (1) and special tool to stop shaft rotation.

Special tool
(A): 09927-76060

9) Tighten new counter shaft nut (2) to specified torque, and caulk counter shaft nut (2) securely.

Tightening torque
counter shaft nut (a): 100 N·m (10.0 kg-m, 75.0 lb-ft)



10) Fit 5th gear shift fork (1) to sleeve (3) and hub (2) assembly, and install them to input shaft and gear shift shaft aligning punch mark (4) with matching mark (5) on input shaft.

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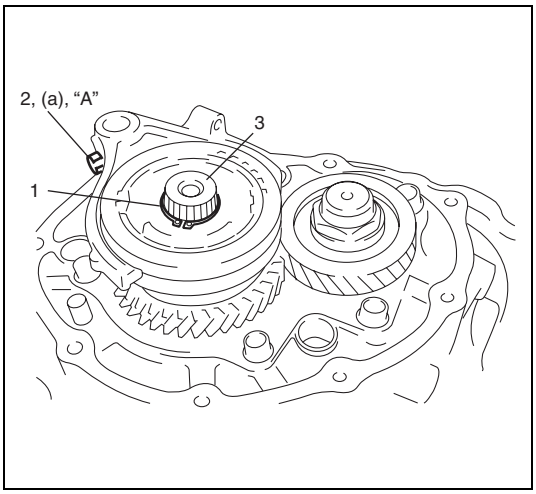


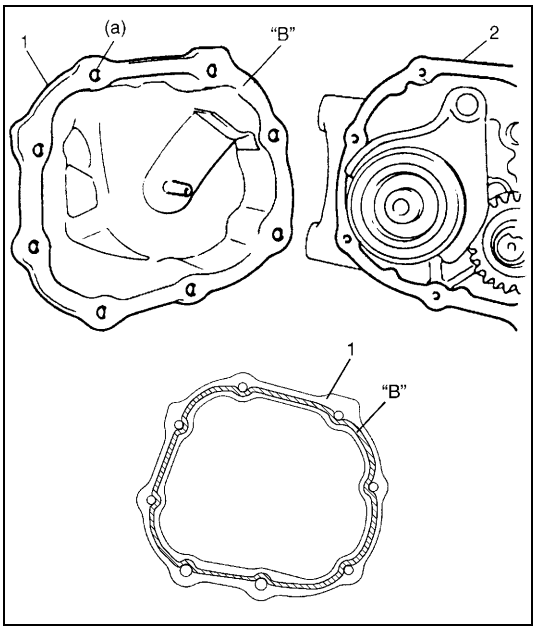
11) Tighten shift fork shaft bolt (2) to which thread lock cement has been applied.

"A": Cement 99000-32110

Tightening torque
Shift fork bolt
(a): 10 N·m (1.0 kg-m, 7.5 lb-ft)

12) Using special tool, install new circlip (1) to input shaft (3) in specified direction as shown in the figure.

Special tool
09900-06107



13) Clean mating surface of both left case (2) and side cover (1), apply sealant to side cover (1) as shown in figure by such amount that its section is 1.5mm (0.059 in.) in diameter, mate it with left case and then tighten bolts.

"B": Sealant 99000-31260

Tightening torque
Side cover bolt (a): 10 N·m (1.0 kg-m, 7.5 lb-ft)

14) Install gear shift & select shaft assembly referring to "Gear Shift and Select Shaft Assembly Removal and Installation" in this section.

Gear Shift Shaft, Input Shaft and Counter Shaft Removal and Installation

Removal

1) Remove gear shift and select shaft assembly referring to "Gear Shift and Select Shaft Assembly Removal and Installation" in this section.
2) Remove fifth gear referring to "Fifth Gear Disassembly and Assembly" in this section.

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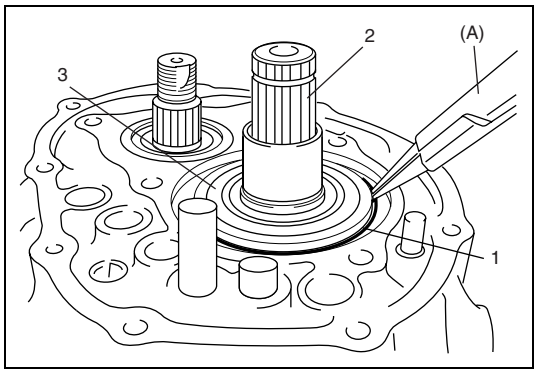
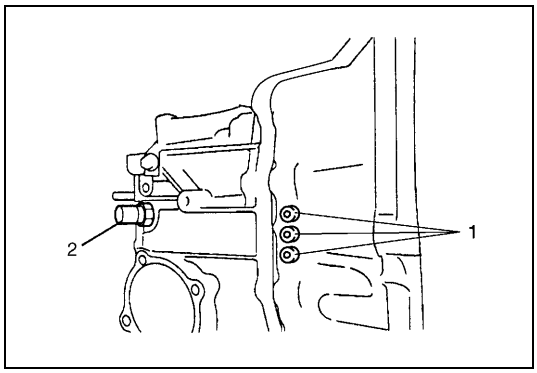


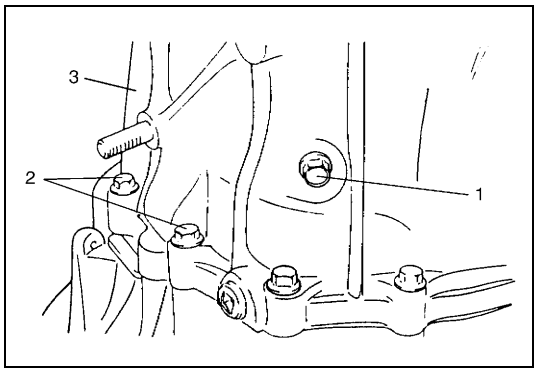
3) Remove snap ring (1) using special tool.

Special tool
(A): 09900-06107

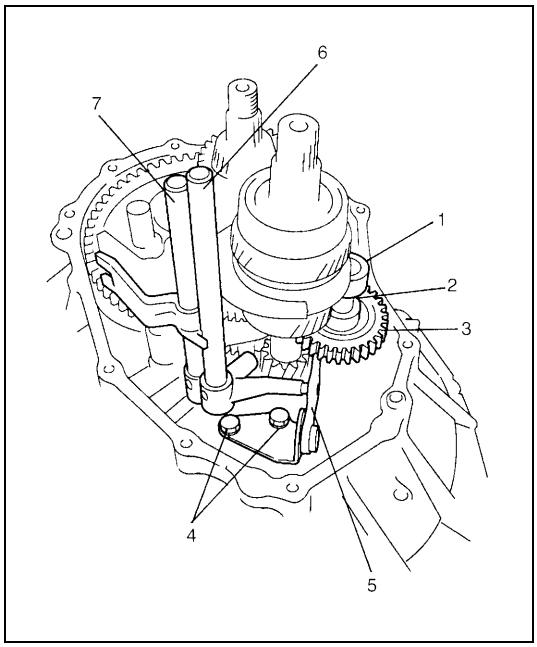
2.	Input shaft
3.	Input shaft left bearing



4) Remove gear shift locating bolts (1) with washers, then take out locating springs and steel balls.
5) Remove back up lamp switch (2).



6) Remove reverse shaft bolt (1) with washer.
7) Remove case bolts (2) from outside and another bolts from clutch housing side.
8) Tapping left case (3) flanges with plastic hammer, remove left case.



9) Pull out reverse gear shaft (1) with washer (2), then take off reverse idler gear (3).
10) Remove reverse gear shift lever bolts (4) and reverse gear shift lever (5).
11) Pull out 5th & reverse gear shift guide shaft (6) together with 5th & reverse gear shift shaft (7).

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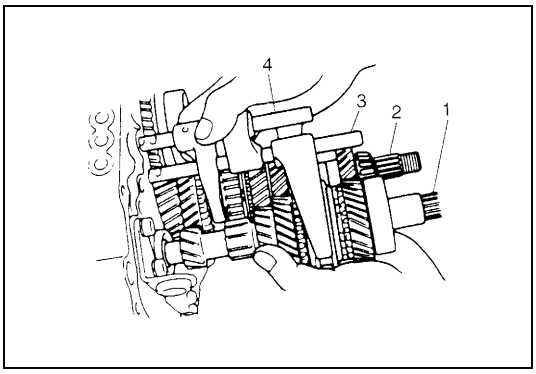
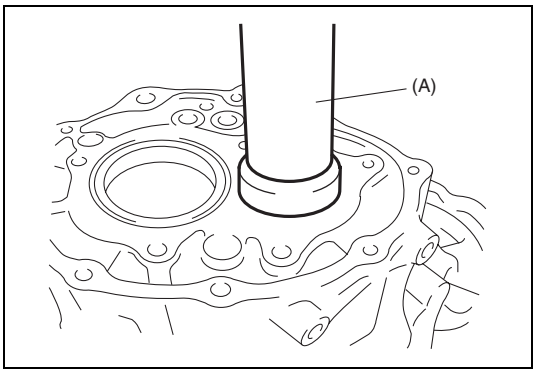


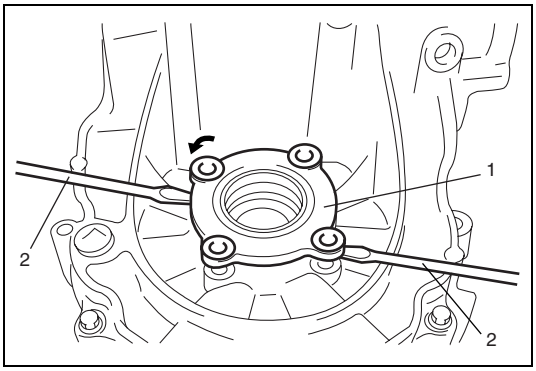
12) Tapping input shaft end with plastic hammer, push it out as assembly from case a little, then take out input shaft assembly (1), counter shaft assembly (2), high speed gear shift shaft (3) and low speed gear shift shaft (4) all at once.



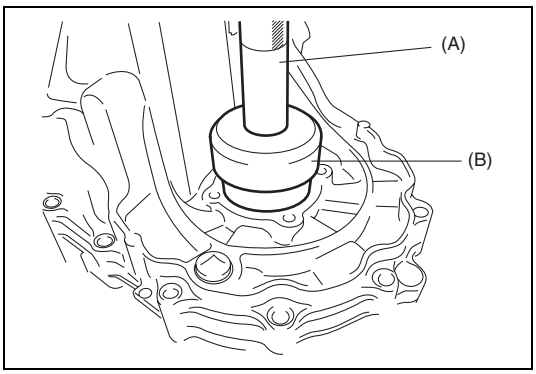
13) Remove counter shaft left bearing outer race from left case using special tool.

Special tool
(A): 09913-70123

14) Remove side bearing retainer bolts.



15) Turn side bearing retainer (1) counterclockwise until it stops, and remove side bearing retainer using 2 flat end rods (2) or the like.
16) Remove O-ring from side bearing retainer (1).
17) Remove differential bearing shim.



18) Remove differential side bearing outer race from left case using special tools.

Special tool
(A): 09924-74510
(B): 09926-27610

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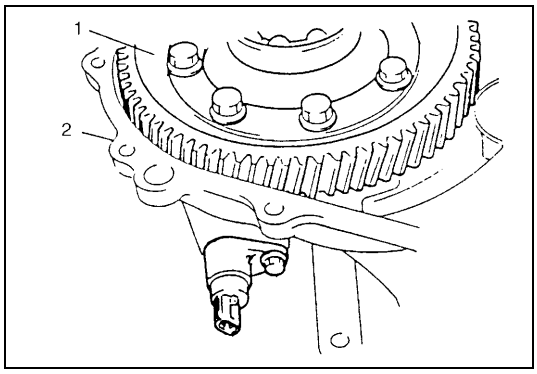
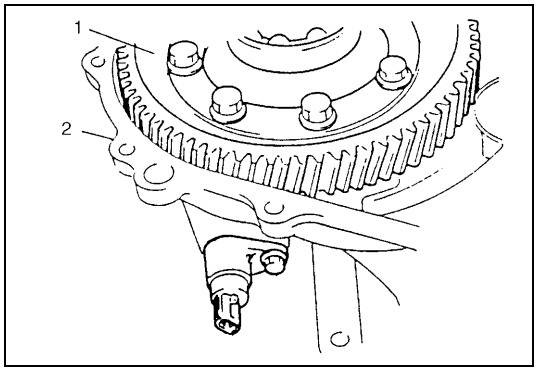
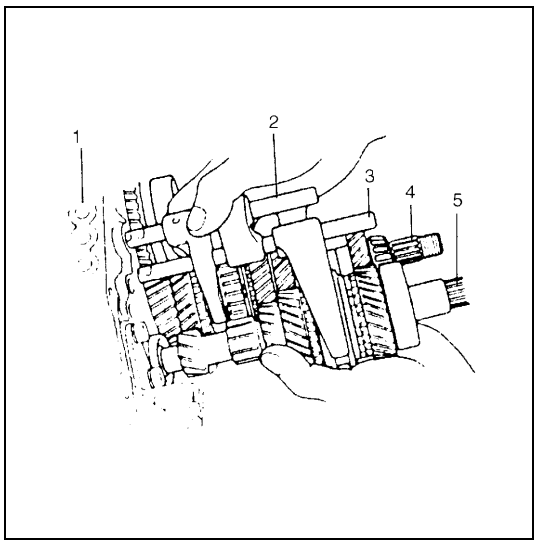


19) Remove differential gear assembly (1) from right case (2).

Installation



1) Install differential assembly (1) into right case (2).

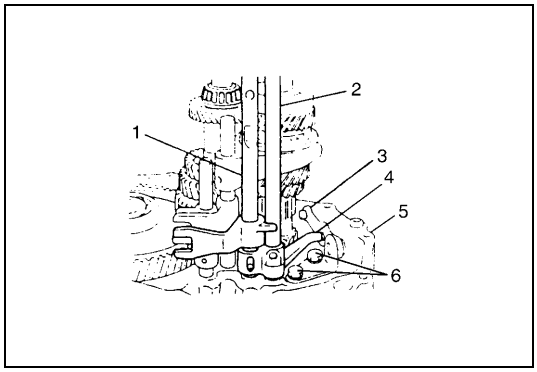


2) Join input shaft (5), counter shaft (4), low speed gear shift shaft (2) and high speed gear shift shaft (3) assemblies all together, then install them into right case (1).

CAUTION:
Take care not to damage oil seal lip by input shaft, or oil leakage may take place.

NOTE:

- **Input shaft right bearing on shaft can be installed into right case tapping shaft with plastic hammer.**
- **Check to make sure that counter shaft is engaged with final gear while installing.**



3) Install 5th & reverse gear shift shaft (1) with 5th & reverse gear shift guide shaft (2) into right case (5). Reverse gear shift arm (4) has to be joined with reverse gear shift lever (3) at the same time.

6. Reverse gear shift lever bolts

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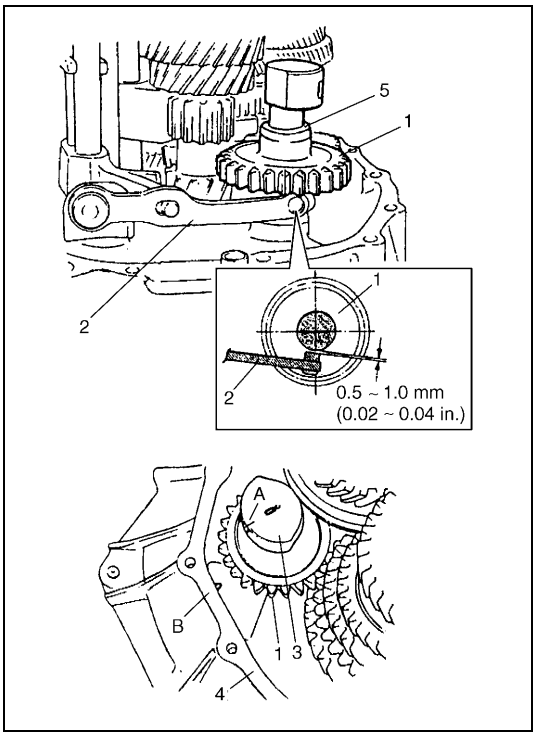


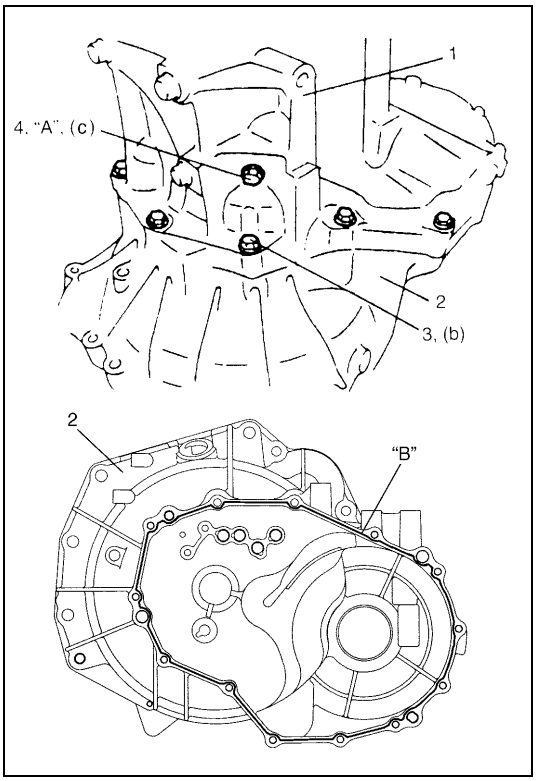
4) Make reverse idler gear (1) with reverse gear shift lever (2), insert reverse gear shaft (3) into case (4) through idler gear and then align “A” in shaft with “B” in case.
5) Fasten reverse gear shift lever bolts after applying thread lock cement.

Thread lock cement: 99000-32110

Tightening torque
Reverse gear shift lever bolt: 23 N·m (2.3 kg-m, 17.0 lb-ft)

NOTE:

- **Make sure that washer (5) has been installed in shaft at above the gear.**
- **Check to confirm that reverse gear shift lever end has clearance 0.5 – 1.0 mm (0.02 – 0.04 in.) to idler gear groove.**



6) Clean mating surfaces of both right and left cases, apply sealant to right case (2) as shown in figure by such amount that its section is 1.5mm (0.059 in.) in diameter then mate it with left case (1).

“B”: Sealant 99000-31260

7) Tighten case bolts (3) from outside to specified torque.

Tightening torque
Transaxle case bolt (b): 23 N·m (2.3 kg-m, 17.0 lb-ft)

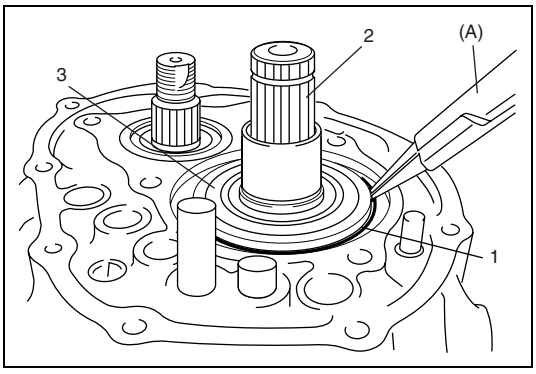
8) Install reverse shaft bolt (4), to which thread lock cement has been applied, with aluminum washer and tighten it.

“A”: Thread lock cement 99000-32110

Tightening torque
Reverse shaft bolt (c): 23 N·m (2.3 kg-m, 17.0 lb-ft)

9) Install another case bolts from clutch housing side and tighten them to specification.

Tightening torque
Transaxle case bolt: 23 N·m (2.3 kg-m, 17.0 lb-ft)



10) Install new snap ring (1) using special tool.

Special tool
(A): 09900-06107

2.	Input shaft
3.	Input shaft left bearing

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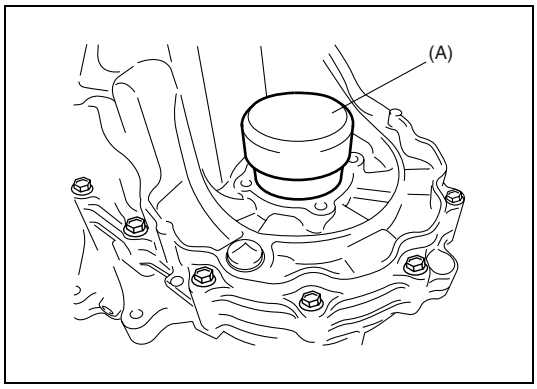
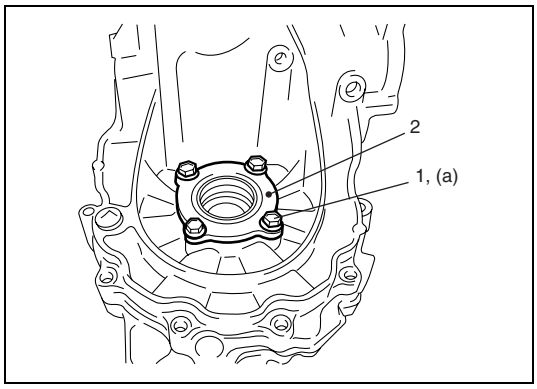


11) Install differential side bearing outer race to left case and then tap and accustom outer race by using special tool and plastic hammer.

CAUTION:
Do not drive in a race with hammer.
Driving it way cause to damage bearing.

Special tool
(A): 09926-27610

12) Select proper size shim according to "Differential Shim Adjustment" in this section.
13) Apply oil to new O-ring of side bearing retainer, and install it with new O-ring to left case.



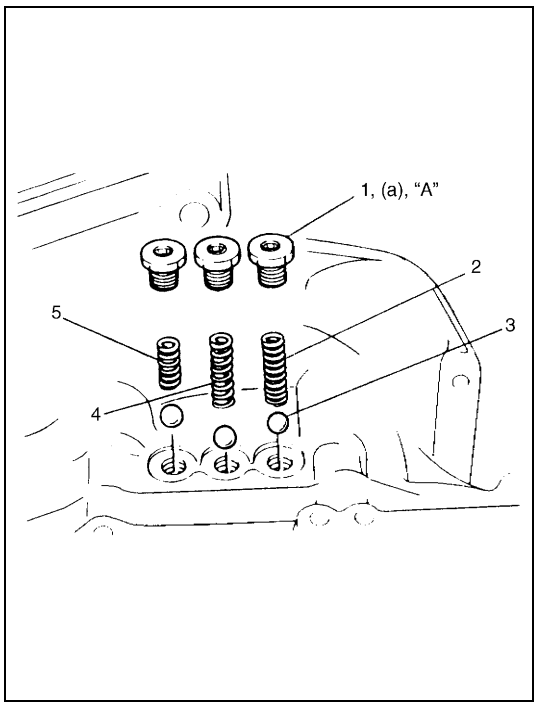
14) Tighten side bearing retainer bolts (1) to specified torque.

NOTE:

- **Install side bearing retainer with its punch mark (2) facing upward.**

Tightening torque
Side bearing retainer bolt (a): 23 N·m (2.3 kg-m, 17.0 lb-ft)

15) Install counter shaft left bearing outer race referring to "Fifth Gears Disassembly and Assembly" in this section.



16) Check locating spring for deterioration and replace with new one as necessary.

Locating spring free length	Standard	Service limit
Low speed (2)	53.1 mm (2.091 in.)	50.5 mm (1.988 in.)
High speed (4)	45.9 mm (1.807 in.)	44.0 mm (1.732 in.)
5th & reverse (5)	29.9 mm (1.777 in.)	28.5 mm (1.122 in.)

17) Install steel balls (3) and locating springs (2, 4 and 5) for respective gear shift shaft and tighten bolts (1) to which sealant has been applied.

Sealant "A": 99000-31260

Tightening torque
Gear shift locating bolt (a): 13 N·m (1.3 kg-m, 9.5 lb-ft)

18) Clean mating surface of guide case.
19) Install fifth gear referring to "Fifth Gear Disassembly and Assembly" in this section.

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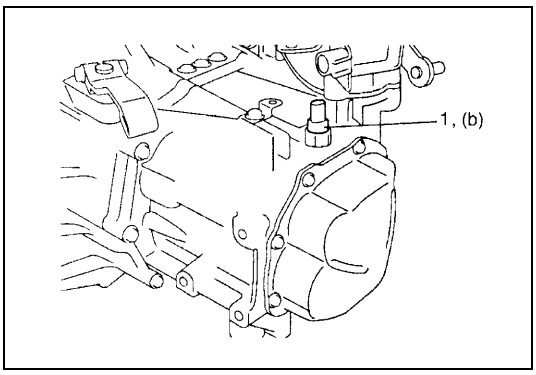
20) Install gear shift and select shaft assembly referring to “Gear Shift and Select Shaft Assembly Removal and Installation” in this section.



21) Tighten back up lamp switch (1) to specified torque.

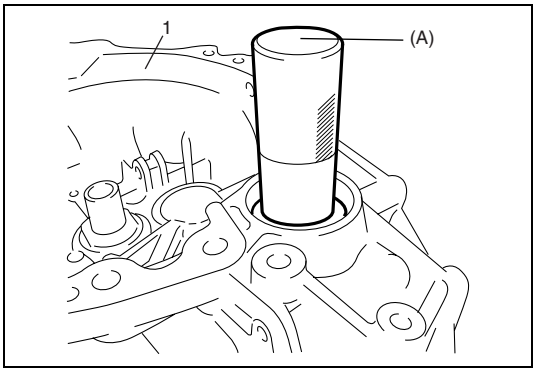
Tightening torque
Back up lamp switch (b): 23 N·m (2.3 kg-m, 17.0 lb-ft)

22) Check input shaft for rotation in each gear position.
23) Also confirm continuity of back up lamp switch in reverse position using ohmmeter.

Transaxle Right Case Disassembly and Assembly

Disassembly

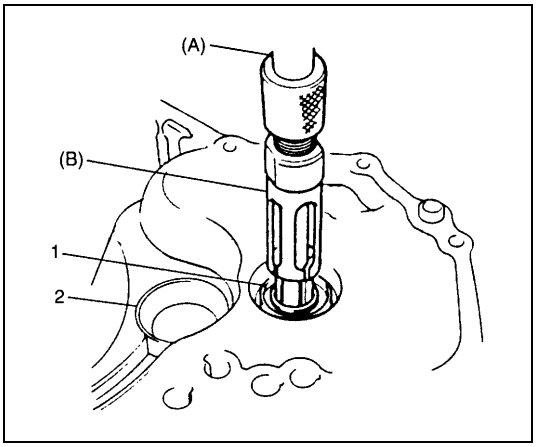
1) Remove gear shift shaft, input shaft and counter shaft referring to “Gear Shift Shaft, Input Shaft and Counter Shaft Removal and Installation” in this section.



2) Remove differential side bearing outer race using special tool.

Special tool
(A): 09925-15410

1. Transaxle right case



3) Remove input shaft oil seal (1) using special tools, if necessary.

Special tool
(A): 09930-30104
(B): 09923-74510

4) Pull out counter shaft right bearing outer race (2) using special tools, if necessary.

Special tool
09930-30104
09941-64511

5) Replace differential side oil seal from right case referring to “Differential Side Oil Seal Replacement” in this section, if necessary.

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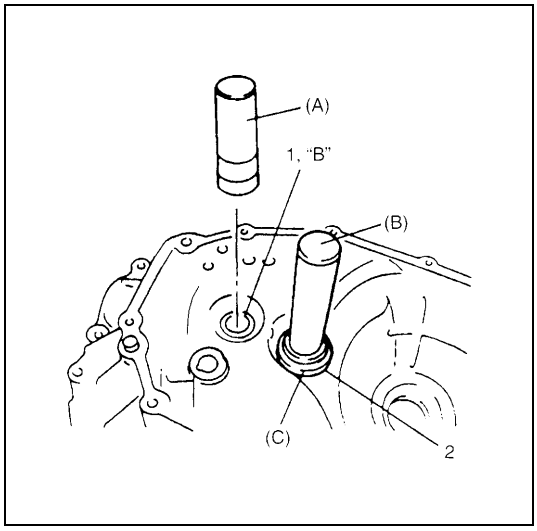
Assembly

NOTE:

Before installation, wash each part and apply specified transaxle oil to sliding faces of bearing and gear.



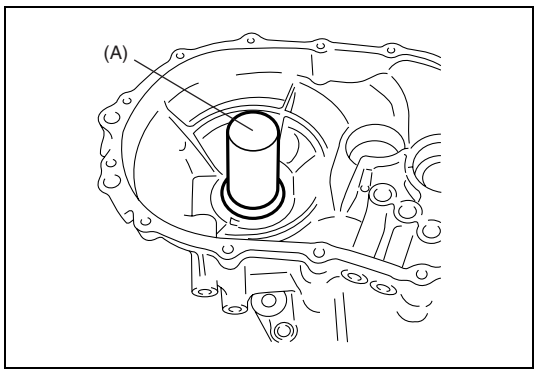
1) If input shaft oil seal (1) has been removed, install it with its spring side facing upward.
   Use special tool and hammer for installation and apply grease to oil seal lip.

"B": Grease 99000-25010

Special tool
(A): 09913-84510

2) If counter shaft right bearing cup (2) has been removed, install it using special tools and hammer.

Special tool
(B): 09925-98210
(C): 09924-84510-004



3) Install differential side bearing outer race to right case using special tool and hammer.

Special tool
(A): 09913-85210

4) Install gear shift shaft, input shaft and counter shaft referring to "Gear Shift Shaft, Input Shaft and Counter Shaft Removal and Installation" in this section.

Transaxle Left Case Disassembly and Assembly

Disassembly

1) Replace differential side oil seal from left case referring to "Differential Side Oil Seal Replacement" in this section, if necessary.

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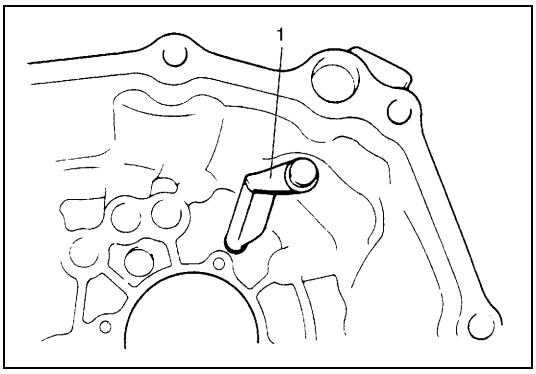
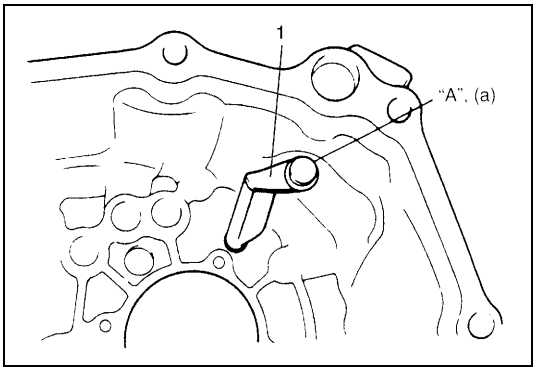


2) Remove input oil gutter (1) from left case, if necessary.

Assembly



1) If input oil gutter (1) has been removed, install it with bolt to which thread lock cement have been applied.

"A": Thread lock cement 99000-32110

Tightening torque
Oil gutter bolt (a): 10 N·m (1.0 kg-m, 7.5 lb-ft)

2) If differential side oil seal is removed, install it to left case referring to "Differential Side Oil Seal Replacement" in this section.

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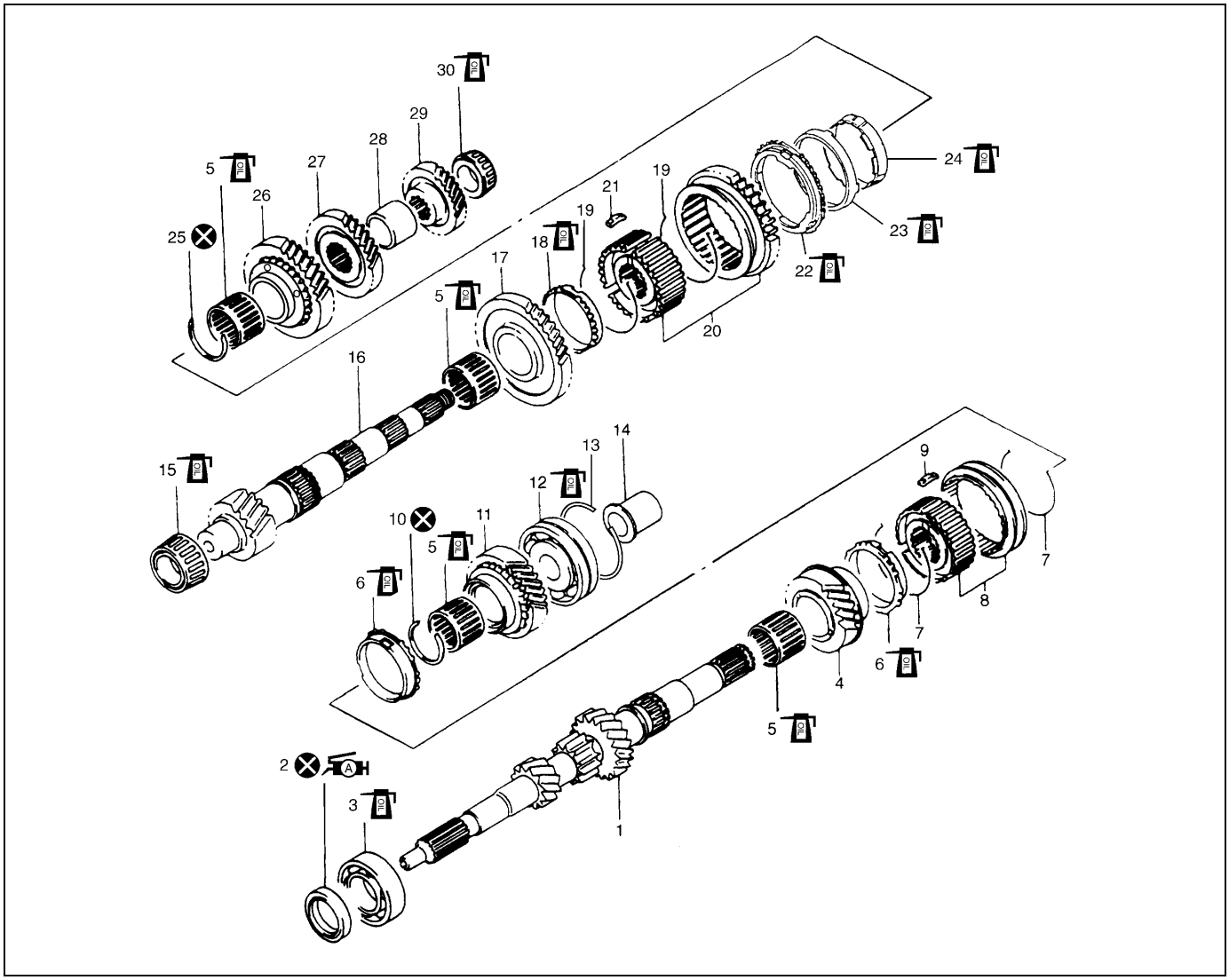
Input & Counter Shaft Components



	1. Input shaft	12. Input shaft left bearing	23. Center cone
A H	2. Oil seal : Apply grease 99000-25010 to oil seal lip.	13. Circlip	24. 2nd gear synchronizer inner ring
	3. Input shaft right bearing	14. 5th gear spacer	25. Circlip
	4. Input shaft 3rd gear	15. counter shaft right bearing	26. counter shaft 2nd gear
	5. Needle bearing (resin cage type)	16. counter shaft	27. counter shaft 3rd gear
	6. High speed synchronizer ring	17. counter shaft 1st gear	28. 3rd & 4th gear spacer
	7. High speed synchronizer spring	18. 1st gear synchronizer ring	29. counter shaft 4th gear
	8. High speed sleeve & hub	19. Low speed synchronizer spring	30. counter shaft left bearing
	9. High speed synchronizer key	20. Low speed sleeve & hub	Do not reuse.
	10. Circlip	21. Low speed synchronizer key	Apply transaxle oil.
	11. Input shaft 4th gear	22. 2nd gear synchronizer outer ring	

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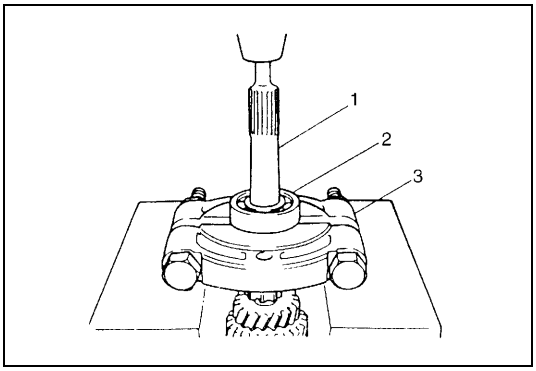
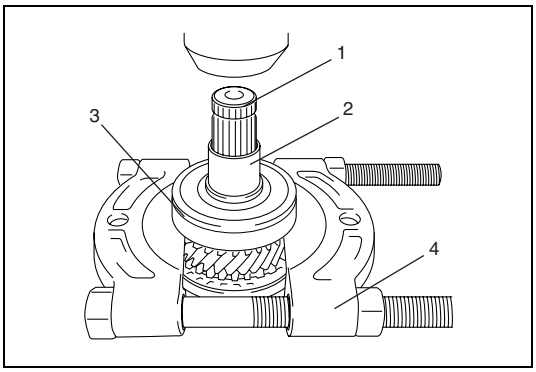
Input Shaft Disassembly and Assembly

Disassembly



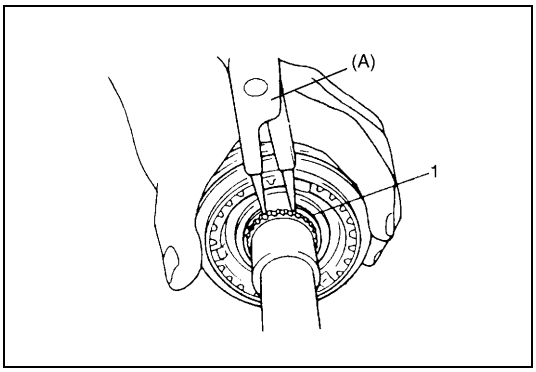
1) Remove input shaft right bearing (2) from input shaft (1) using bearing puller (3) and press.



2) Drive out 5th gear spacer (2) and left bearing (3) from input shaft (1) using puller (4) and press.

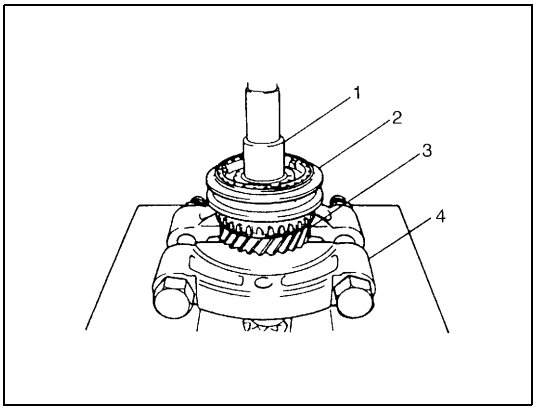
CAUTION:
To avoid gear tooth from being damaged, support it at flat side of bearing puller.

3) Take out 4th gear, 4th gear needle bearing of resin cage type and high speed synchronizer ring.



4) Using special tool, remove circlip (1).

Special tool
(A): 09900-06107



5) Drive out high speed synchronizer sleeve & hub assembly (2) together with 3rd gear (3) from input shaft (1) using puller (4) and press.

CAUTION:
Make sure to use flat side of puller to avoid causing damage to 3rd gear tooth.

6) Take out 3rd gear needle bearing of resin cage type from shaft.
7) Disassemble synchronizer sleeve & hub assembly.

Assembly

1) Clean all components thoroughly, inspect them for any abnormality and replace with new ones as necessary.

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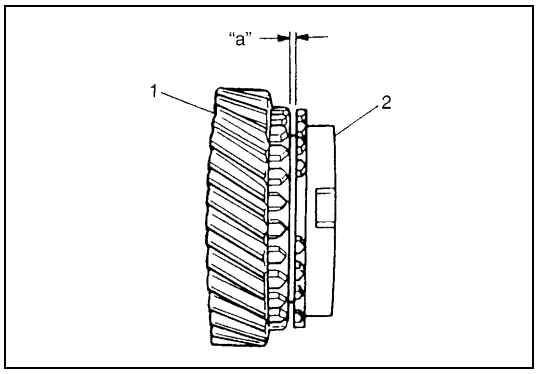
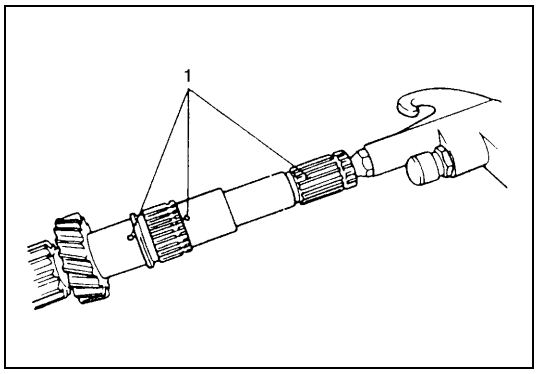
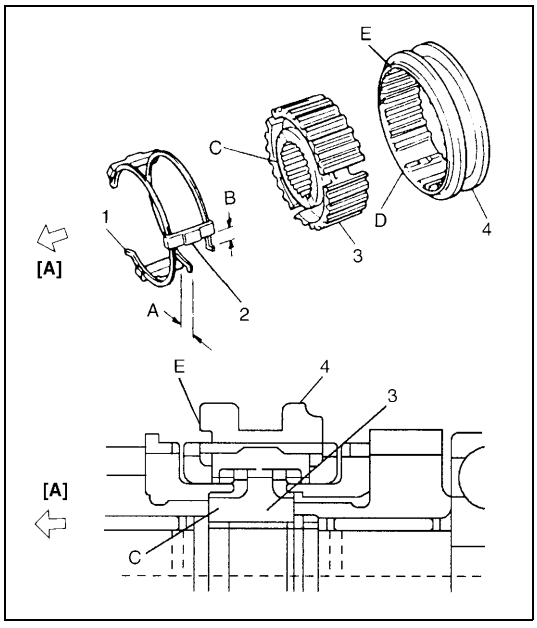


2) If synchronizer parts need to be repaired, check clearance "a" between ring (2) and gear (1), each chamfered tooth of gear, ring and sleeve, then determine parts replacement.

Clearance between synchronizer ring and gear
Standard "a": 1.0 – 1.4 mm (0.040 – 0.055 in.)
Service limit "a": 0.5 mm (0.020 in.)



3) To ensure lubrication, air blow oil holes (1) and make sure that they are free from any obstruction.



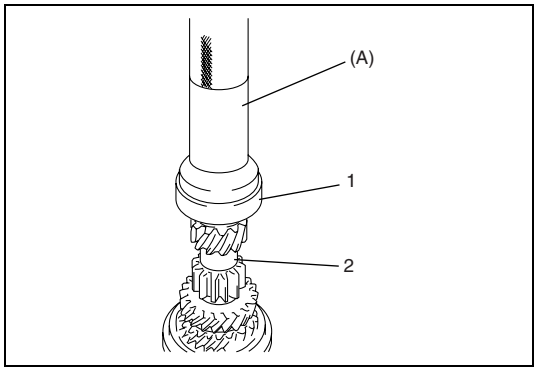
4) Fit high speed synchronizer sleeve (4) to hub (3), insert 3 keys (2) in it and then set springs (1) as shown in figure.

NOTE:

- **No specific direction is assigned to each key but it is assigned as sleeve & hub assembly.**
- **Size of high speed synchronizer sleeve, hub, keys and springs is between those of low speed and 5th speed ones.**

Synchronizer key installation position
: A = B

[A]:	3rd gear side
C:	Long flange
D:	Key way
E:	Projecting end



5) Drive in right bearing (1) to input shaft (2) using special tool and hammer.

Special tool
(A): 09951-16080

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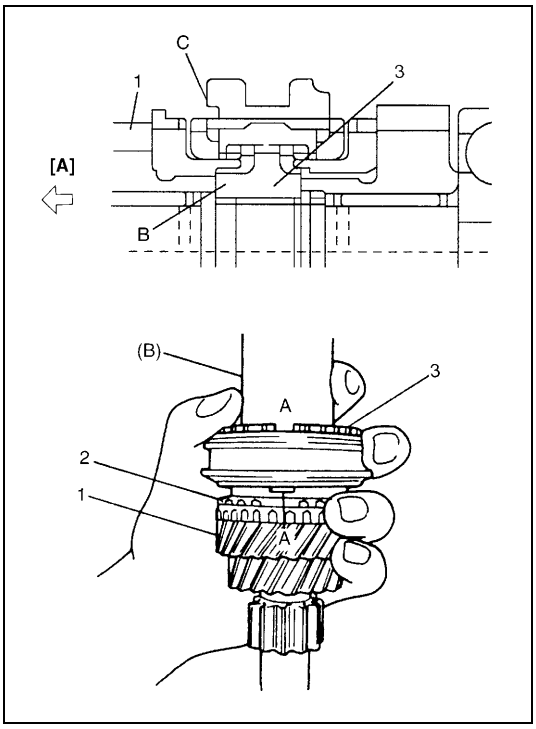


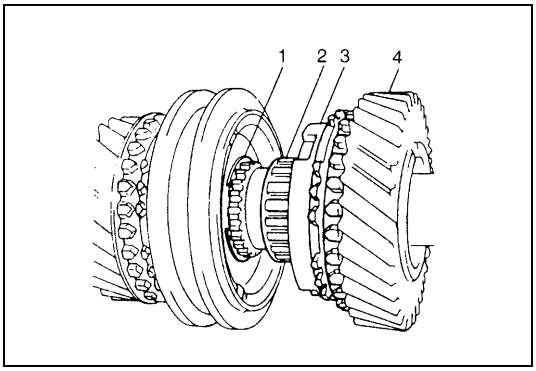
6) Install 3rd gear needle bearing of resin cage type, apply oil to it, then install 3rd gear (1) and synchronizer ring (2).
7) Drive in high speed sleeve & hub assembly (3) using special tool and hammer, facing long flange side of hub to 3rd gear.

NOTE:

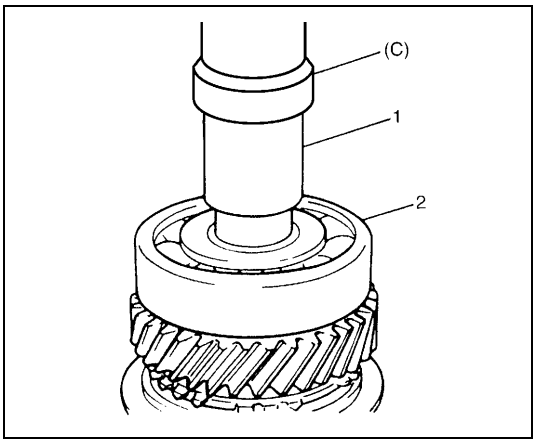
- **While press-fitting sleeve & hub, make sure that synchronizer ring key slots are aligned with keys in sleeve & hub assembly.**
- **Check free rotation of 3rd gear after press-fitting sleeve & hub assembly.**
- **Synchronizer rings for 3rd and 4th are identical.**

Special tool
(B): 09913-84510

[A]:	3rd gear side
A:	Key way
B:	Long flange
C:	Projecting end



8) Install circlip (1) and confirm that circlip is installed in groove securely.
Install needle bearing (2) of resin cage type, apply oil to bearing and then install synchronizer ring (3) and 4th gear (4).



9) Press-fit left bearing (2) using special tool and hammer.

Special tool
(C): 09913-70123

10) Using the same special tool at step 9), drive in 5th gear spacer (1).

CAUTION:
To prevent 5th gear spacer from being distorted because of excessive compression, do not press-fit it with left bearing at once.

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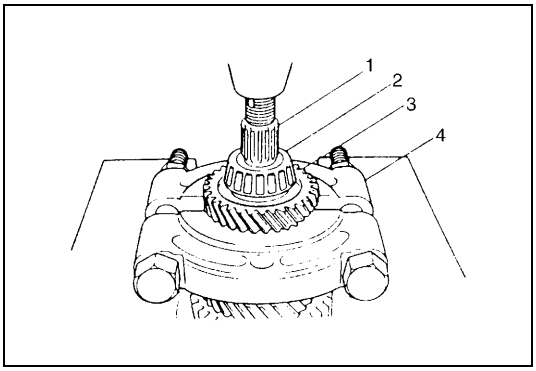
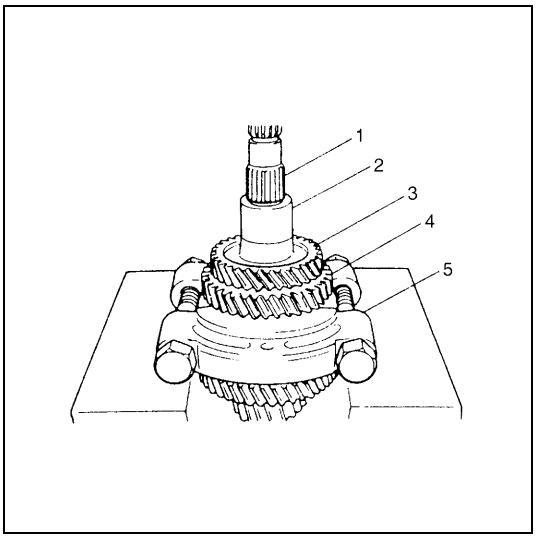
Counter Shaft Disassembly and Assembly

Disassembly



1) Drive out left bearing cone (2) with 4th gear (3) from counter shaft (1) using puller (4) and press.

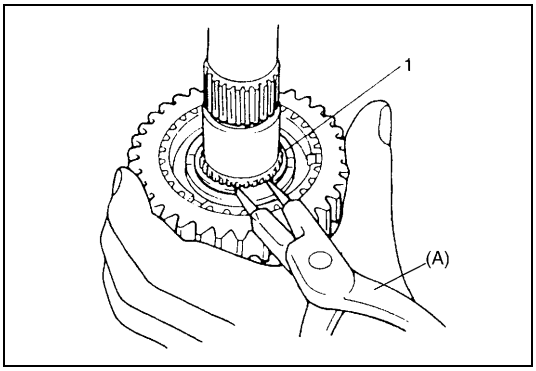
CAUTION:
- **Use puller and press that will bear at least 5 ton (11,000 lb) safely.**
- **To avoid tooth damage, support 4th gear at flat side of puller.**



2) Apply puller (5) to 2nd gear (4) and drive out 3rd & 4th gear spacer (2) and 3rd gear (3) together with 2nd gear (4) from counter shaft (1) using press. Take out needle bearing of resin cage type from counter shaft.

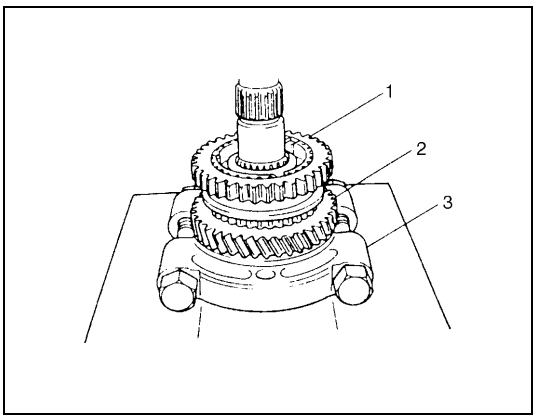
CAUTION:
- **If compression exceeds 5 ton (11,000 lb), release compression once, reset puller support and then continue press work again.**
- **To avoid gear tooth from being damaged, support it at flat side of bearing puller.**

3) Take out 2nd synchronizer outer ring, center cone and inner ring.



4) Using special tool, remove circlip (1).

Special tool
(A): 09900-06107



5) Apply puller (3) to 1st gear (2) and drive out low speed synchronizer sleeve & hub assembly with 1st gear (1) using press.

CAUTION:
To avoid gear tooth from being damaged, support it at flat side of bearing puller.

6) Disassemble synchronizer sleeve & hub assembly.
7) Take out 1st gear needle bearing of resin cage type from shaft.

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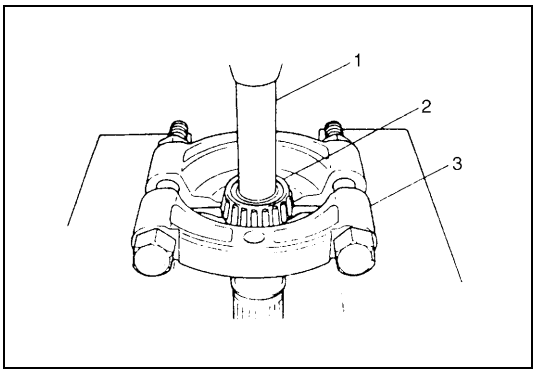
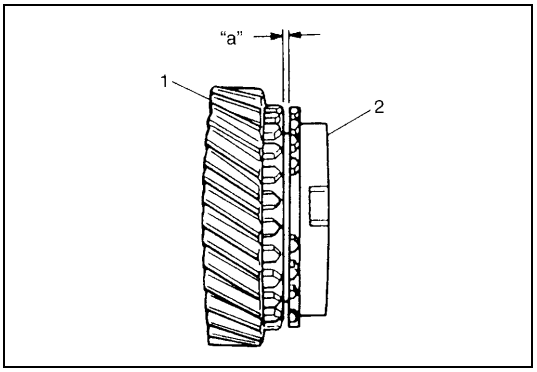


8) Remove right bearing cone (2) using puller (3), metal stick (1) and press.

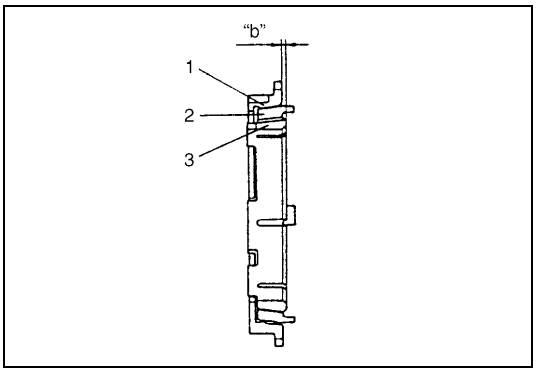
Assembly

1) Clean all components thoroughly, inspect them for any abnormality and replace with new ones as necessary.



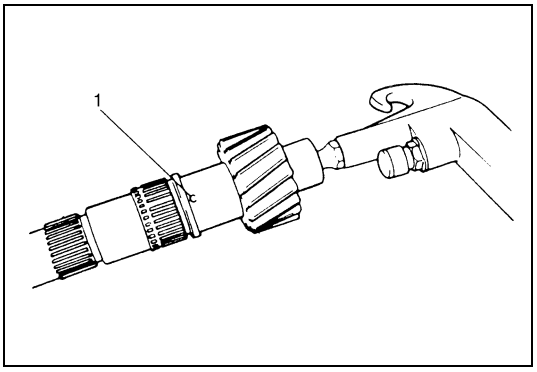
2) If synchronizer parts need to be repaired, check clearance "a" between ring (2) and gear (1), each chamfered tooth of gear, ring and sleeve, then determine parts replacement.

Clearance between synchronizer ring and gear
Standard "a": 1.0 – 1.4 mm (0.040 – 0.055 in.)
Service limit "a": 0.5 mm (0.020 in.)



3) Put the synchronizer outer ring (1), inner ring (3) and the cone (2) together and then measure the step difference between the outer ring and the inner ring. And also check each chamfered tooth of gear and synchronizer ring and replace with new one, if necessary. Also, check gear tooth.

Difference between synchronizer outer ring and inner ring
Standard "b": 1.0 – 1.4 mm (0.040 – 0.055 in.)
Service limit "b": 0.5 mm (0.020 in.)



4) To ensure lubrication, air blow oil holes (1) and make sure that they are free from any obstruction.

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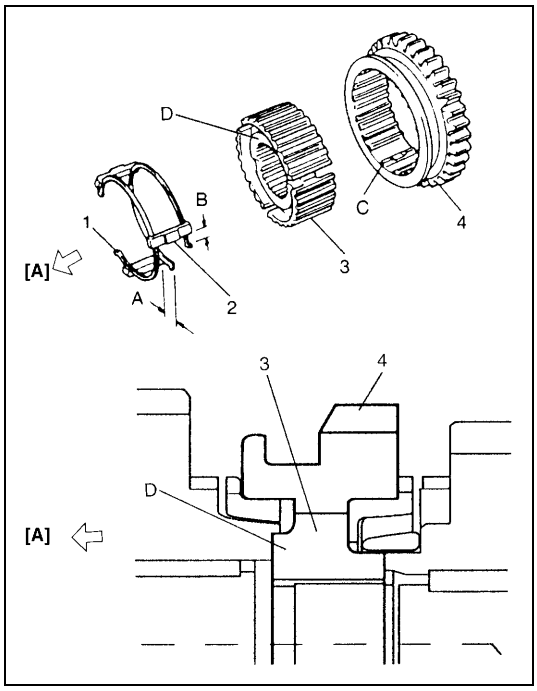


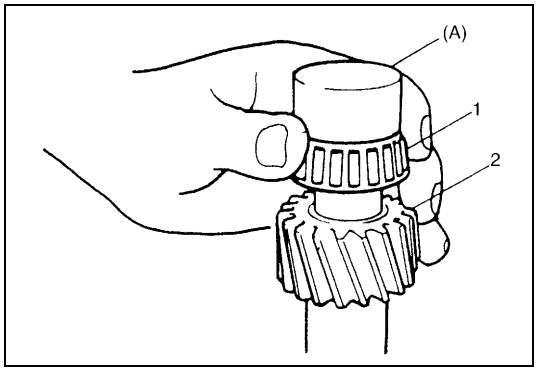
5) Fit low speed synchronizer sleeve (4) to hub (3), insert 3 keys (2) in it and then set springs (1) as shown in figure.

NOTE:

- **No specific direction is assigned to each key but it is assigned as sleeve & hub assembly.**
- **Size of low speed synchronizer keys and springs are the largest compared with those of high speed and 5th speed ones.**

Synchronizer key installation position
: A = B

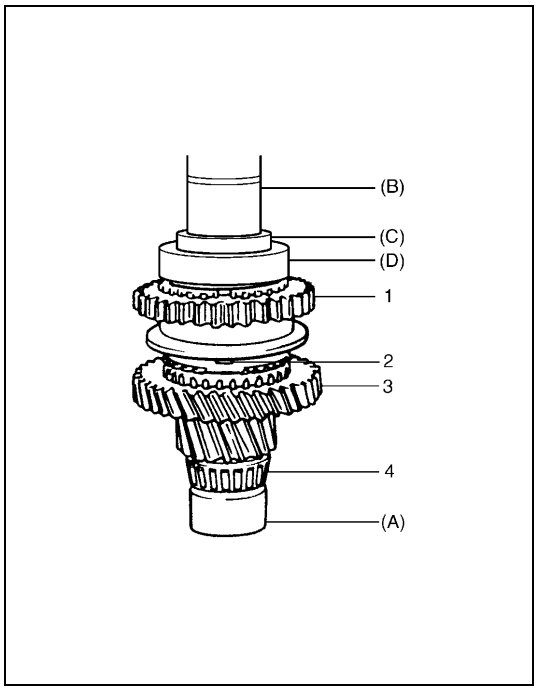
[A]:	1st gear side
C:	Key way
D:	Short flange



6) Install right bearing cone (1) to counter shaft (2) using special tool and hammer.

Special tool
(A): 09923-78210

7) Install needle bearing of resin cage type, apply oil to it, then install 1st gear and 1st gear synchronizer ring.



8) Drive in low speed sleeve & hub assembly (1) using special tools and hammer, facing “B” side of sleeve to 1st gear.

NOTE:

- **Support shaft with special tool as shown in figure so that retainer of bearing cone (4) will be free from compression.**
- **Make sure that synchronizer ring (2) key slots are aligned with keys while press-fitting sleeve & hub assembly.**
- **Check free rotation of 1st gear (3) after press-fitting sleeve & hub assembly.**

Special tool
(A): 09923-78210
(B): 09940-51710
(C): 09924-07730
(D): 09924-07710

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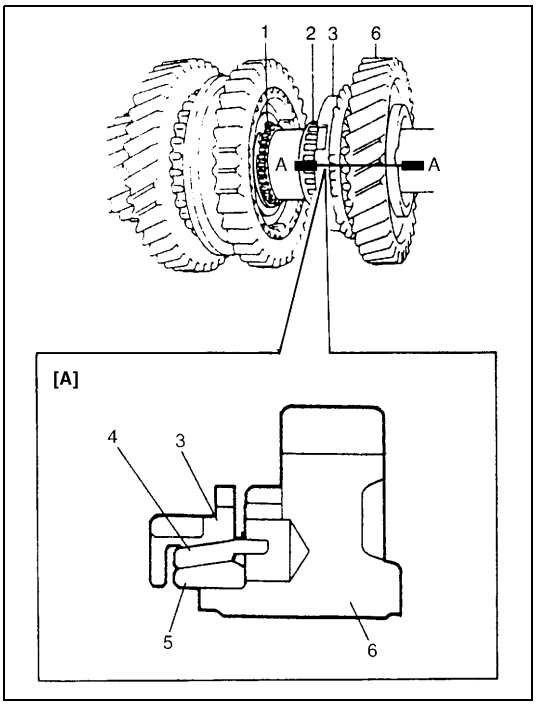
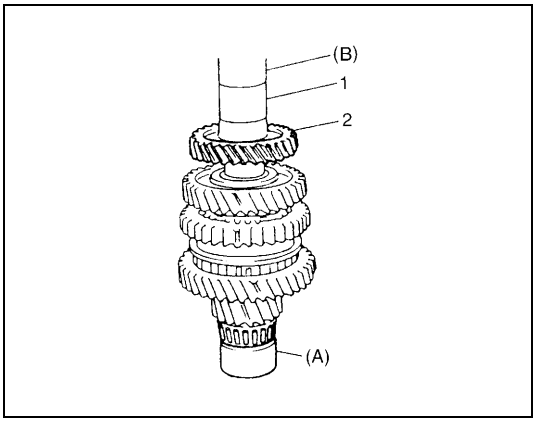


9) Install circlip (1) and confirm that circlip is installed in groove securely.
   Install needle bearing (2) of separated steel cage type, apply oil to bearing.
   With synchronizer outer ring (3), center cone (4) & inner ring (5) put together and installed to 2nd gear (6) as shown in figure.

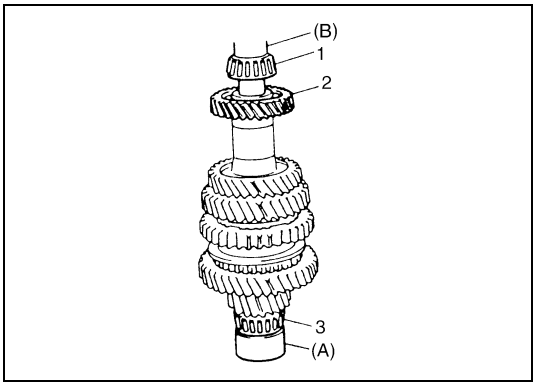
[A]: Section A - A



10) Press-fit 3rd gear (2) and spacer (1) using special tools and press.

CAUTION:
Press-fit 3rd gear (2) and spacer (1) first, and then 4th gear later separately so that counter shaft will not be compressed excessively.

Special tool
(A): 09923-78210
(B): 09913-84510



11) Press-fit 4th gear (2) using the same procedure as step 10).
12) Install left bearing cone (1) using special tools and hammer.

NOTE:
For protection of right bearing cone (3), always support shaft with special tool as illustrated.

Special tool
(A): 09923-78210
(B): 09913-80113

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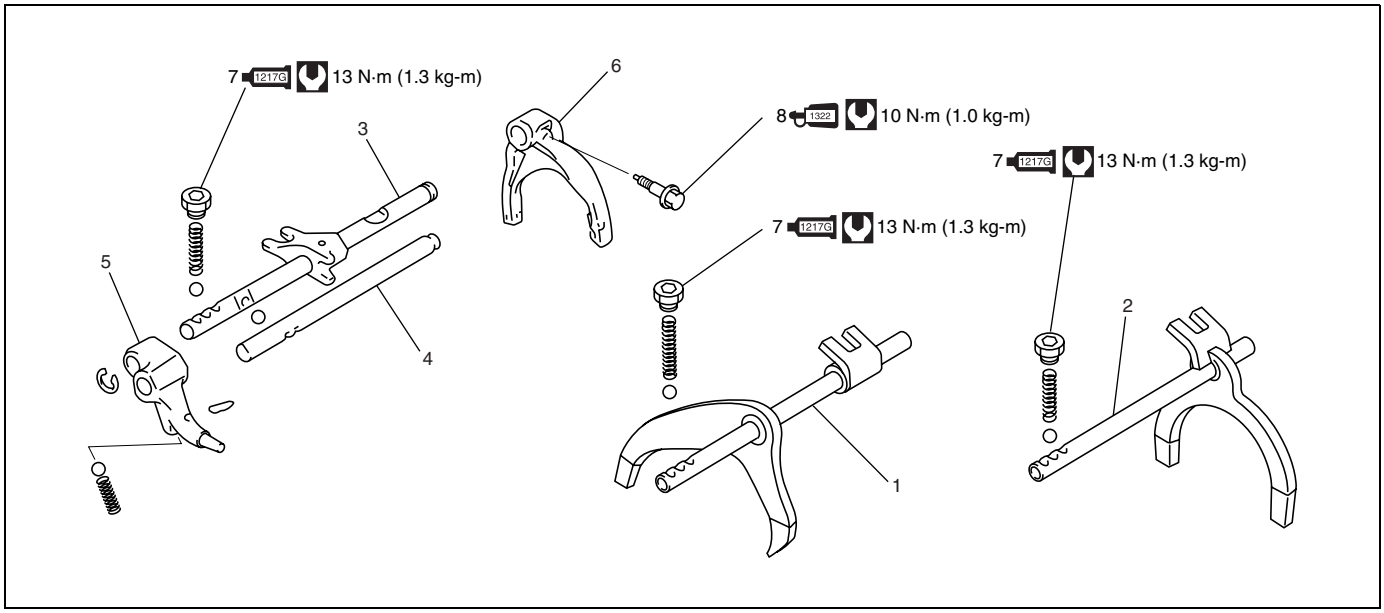
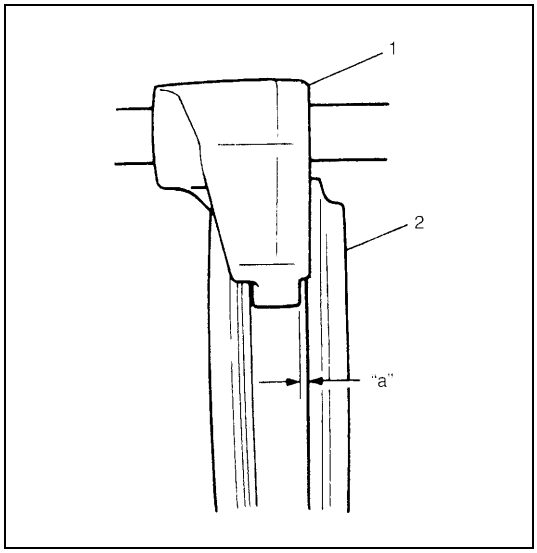
Gear Shift Shaft Components



1. Low speed gear shift shaft	4. 5th & reverse gear shift guide shaft	1217G	7. Gear shift locating bolt : Apply sealant 99000-31260 to bolt thread.
2. High speed gear shift shaft	5. Reverse gear shift arm	1322	8. Shift fork bolt : Apply thread lock 99000-32110 to bolt thread.
3. 5th & reverse gear shift shaft	6. 5th gear shift fork		Tightening torque

High Speed and Low Speed Gear Shift Shafts Inspection



1) Using feeler gauge, check clearance between fork (1) and sleeve (2) and replace those parts if it exceeds limit below.

NOTE:

For correct judgement of parts replacement, carefully inspect contact portion of fork and sleeve.

Clearance between fork and sleeve
Service limit "a": 1.0 mm (0.039 in.)

2) Insert each gear shift shaft into case and check that it moves smoothly. If it doesn't, correct using oilstone, reamer or the like.

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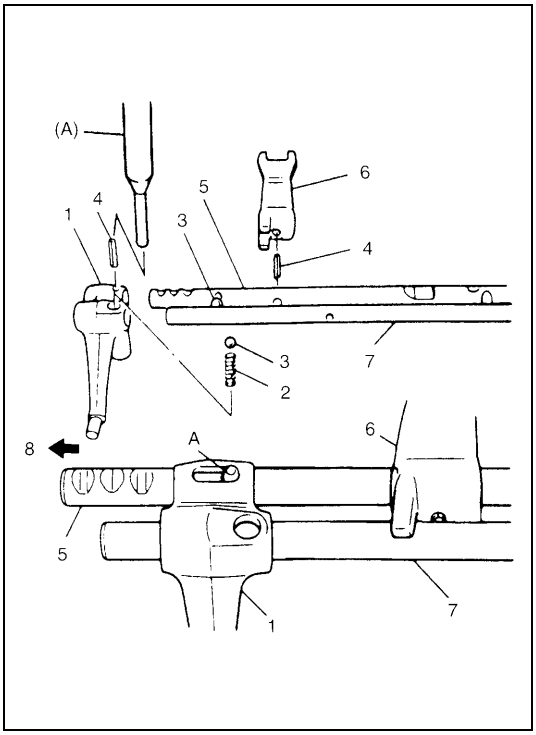
5th & Reverse Gear Shift Shafts Disassembly and Assembly

Disassembly



Disassemble component parts using special tool and hammer.

Special tool
(A): 09922-85811

Assembly

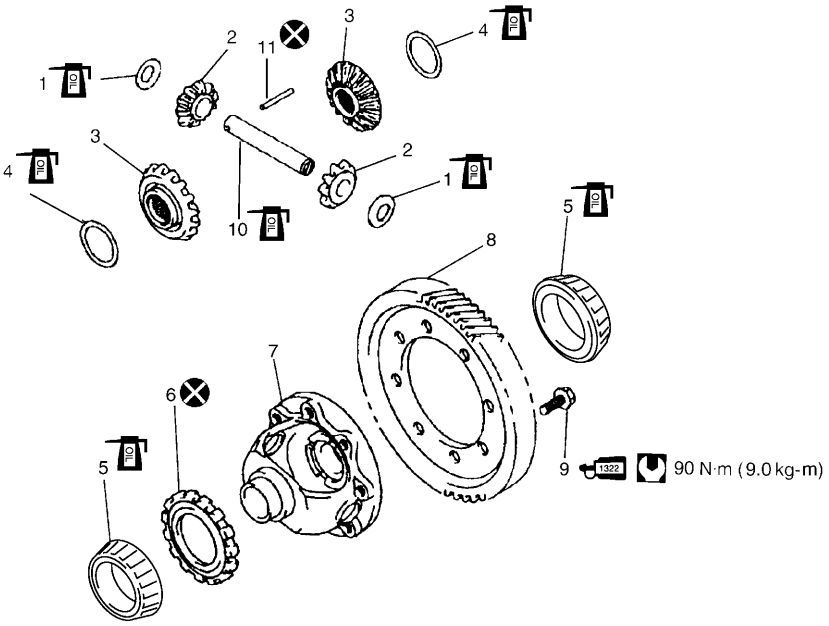
Replace or correct parts as required and assemble shafts making sure that component parts are in proper order as shown in figure.

NOTE:

- **Distinguish reverse gear shift arm spring (Blue) (2) from low speed locating spring (Yellow).**
- **Install 2 steel balls (3) in reverse gear shift arm (1) without fail.**
- **Drive in spring pin for reverse gear shift arm (1) facing slit A toward 5th gear side.**

4. Spring pin	7. 5th & reverse gear shift guide shaft
5. 5th & reverse gear shift shaft	8. 5th gear side
6. 5th & reverse gear shift yoke	A: Face pin slit toward 5th gear side

Differential Components



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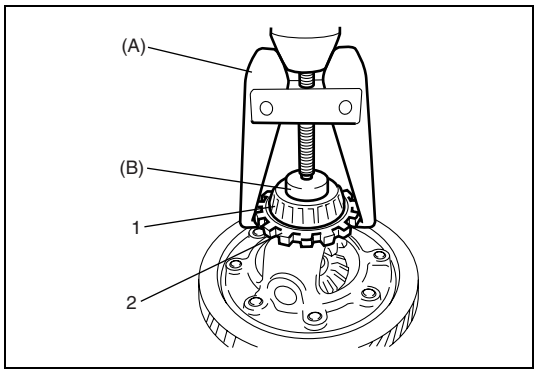
1. Differential pinion washer	8. Final gear
2. Differential side pinion gear	9. Final gear bolt : Apply thread lock 99000-32110 to all around thread part of bolt
3. Differential side gear	10. Differential pinion shaft
4. Side gear washer	11. Differential pinion shaft pin
5. Differential side bearing	Tightening torque
6. Speed sensor ring	Do not reuse.
7. Differential case	Apply transaxle oil.

Differential Disassembly and Assembly

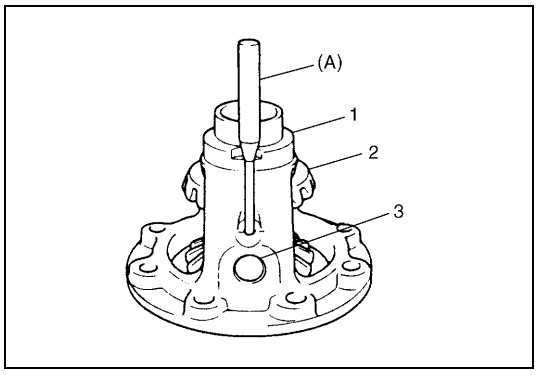
Disassembly



1) Using special tools, remove right bearing (1) and sensor rotor (2).

Special tool
(A): 09913-60910
(B): 09925-88210

2) Remove left bearing in the same manner at step 1).
3) Support differential case with soft jawed vise and remove final gear bolts then take out final gear.

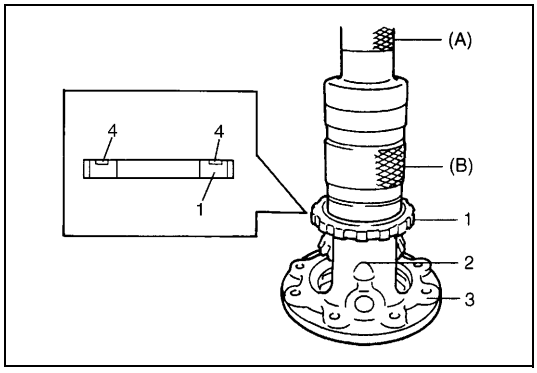


4) Using special tool and hammer, drive out differential pinion shaft pin and then disassemble component parts.

Special tool
(A): 09922-85811

1. Differential case
2. Differential gear
3. Differential pinion shaft

Assembly



1) Drive in new differential pinion shaft pin (2) till the depth from differential case (3) surface is about 1 mm (0.04 in.).
2) Press-fit new sensor rotor (1) whose groove (4) facing upward using special tools and copper hammer.

Special tool
(A): 09913-76010
(B): 09940-54910

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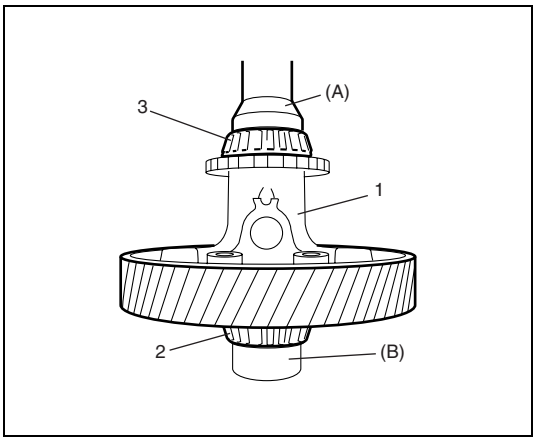
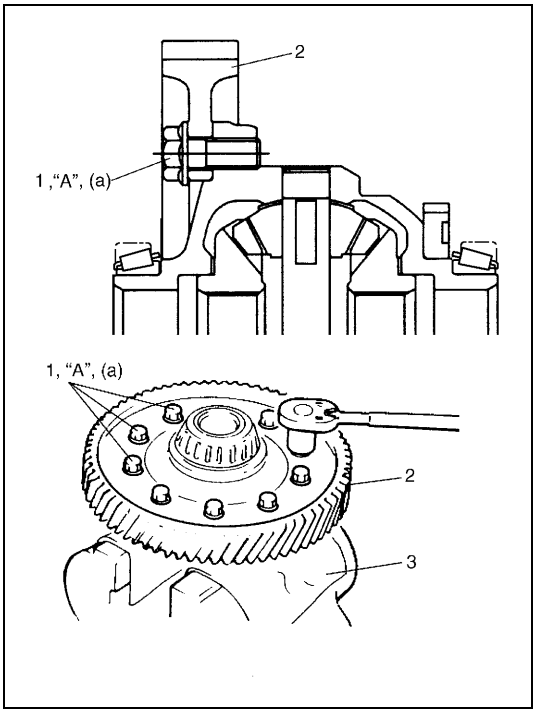


3) Press-fit left bearing (2) using special tools and copper hammer.

Special tool
(A): 09913-76010

4) Support differential assembly (1) as illustrated so as to left bearing (2) is floating, and then press-fit right bearing (3) using special tool.

Special tool
(A): 09913-76010
(B): 09951-16060



5) Hold differential assembly with soft jawed vise (3), install final gear (2) as shown in figure and then tighten bolts (1) with thread lock cement applied to specified torque.
Apply thread lock cement to bolt thread when reusing bolts.

CAUTION:
Use of any other bolts than specified ones is prohibited.

"A": Thread lock cement 99000-32110

Tightening torque
Final gear bolt (a): 90 N·m (9.0 kg-m, 65.0 lb-ft)

Differential Adjustment

Judging from abnormality noted before disassembly and what is found through visual check of component parts after disassembly, prepare replacing parts and proceed to reassembly. Make sure that all parts are clean.

1) Assemble differential gear and measure thrust play of differential gear as follows.

Differential gear thrust play
: 0.03 – 0.31 mm (0.001 – 0.012 in.)

- For left side

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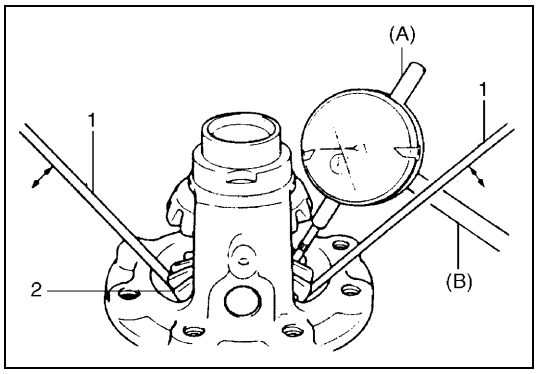
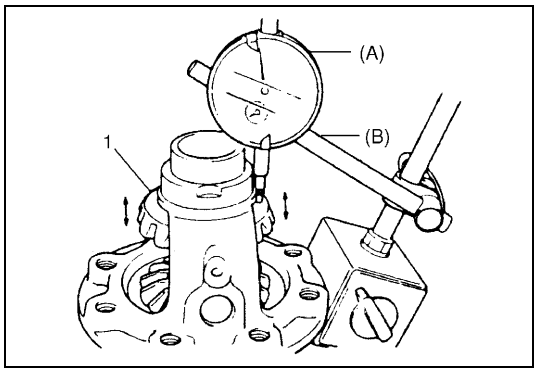


a) Hold differential assembly with soft jawed vise and apply measuring tip of dial gauge to top surface of gear.
b) Using 2 screwdrivers (1), move gear (2) up and down and read movement of dial gauge pointer.

Special tool
(A): 09900-20606
(B): 09900-20701



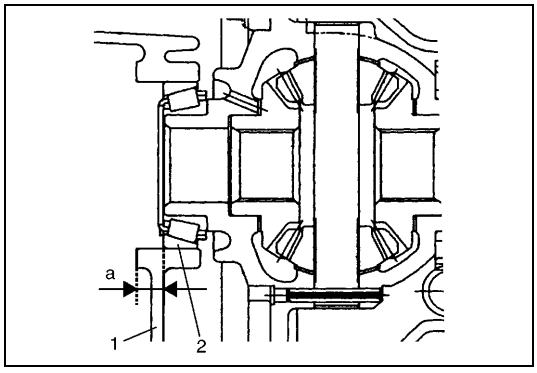
- For right side

a) Using similar procedure to the above, set dial gauge tip to gear (1) shoulder.
b) Move gear up and down by hand and read dial gauge.

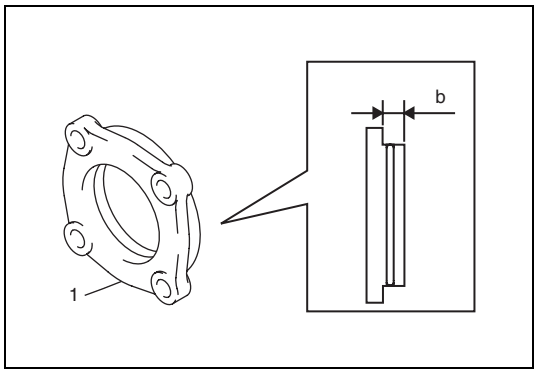
Special tool
(A): 09900-20606
(B): 09900-20701

2) If thrust play is out of specification, select suitable thrust washer from among the following available size, install it and check again that specified gear play is obtained.

Available thrust washer thickness
0.85, 0.9, 0.95, 1.0, 1.05, 1.1 and 1.15 mm
(0.033, 0.035, 0.037, 0.039, 0.041, 0.043 and 0.045 in.)



3) Measure depth “a” from left case (1) face to side bearing outer race (2) using depth gauge.



4) Measure height “b” of side bearing retainer (1) with depth gauge.

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5) Calculate clearance a – b, and select differential shim according to the following table.

Bearing shim

Clearance a – b	Thickness of bearing shim to be installed
0.636 – 0.665 mm (0.0250 – 0.0261 in.)	0.75 mm (0.030 in.)
0.666 – 0.695 mm (0.0262 – 0.0273 in.)	0.78 mm (0.031 in.)
0.696 – 0.725 mm (0.0274 – 0.0285 in.)	0.81 mm (0.032 in.)
0.726 – 0.755 mm (0.0286 – 0.0297 in.)	0.84 mm (0.033 in.)
0.756 – 0.785 mm (0.0298 – 0.0309 in.)	0.87 mm (0.034 in.)
0.786 – 0.815 mm (0.0310 – 0.0320 in.)	0.90 mm (0.035 in.)
0.816 – 0.845 mm (0.0321 – 0.0332 in.)	0.93 mm (0.037 in.)
0.846 – 0.875 mm (0.0333 – 0.0344 in.)	0.96 mm (0.038 in.)
0.876 – 0.905 mm (0.0345 – 0.0356 in.)	0.99 mm (0.039 in.)
0.906 – 0.935 mm (0.0357 – 0.0368 in.)	1.02 mm (0.040 in.)
0.936 – 0.965 mm (0.0369 – 0.0379 in.)	1.05 mm (0.041 in.)
0.966 – 0.995 mm (0.0380 – 0.0391 in.)	1.08 mm (0.043 in.)
0.996 – 1.025mm (0.0392 – 0.0403 in.)	1.11 mm (0.044 in.)
1.026 – 1.055 mm (0.0404 – 0.0415 in.)	1.14 mm (0.045 in.)
1.056 – 1.085 mm (0.0416 – 0.0427 in.)	1.17 mm (0.046 in.)
1.086 – 1.115 mm (0.0428 – 0.0438 in.)	1.20 mm (0.047 in.)
1.116 – 1.145 mm (0.0439 – 0.0450 in.)	1.23 mm (0.048 in.)
1.146 – 1.175 mm (0.0451 – 0.0462 in.)	1.26 mm (0.050 in.)
1.176 – 1.205 mm (0.0463 – 0.0474 in.)	1.29 mm (0.051 in.)
1.206 – 1.235 mm (0.0475 – 0.0486 in.)	1.32 mm (0.052 in.)
1.236 – 1.265 mm (0.0487 – 0.0498 in.)	1.35 mm (0.053 in.)
1.266 – 1.295 mm (0.0499 – 0.0509 in.)	1.38 mm (0.054 in.)
1.296 – 1.325 mm (0.0510 – 0.0521 in.)	1.41 mm (0.056 in.)

Tightening Torque Specification

Fastening part	Tightening torque		
	N•m	kg-m	lb-ft
Transaxle oil level/filler and drain plugs	21	2.1	15.5
Oil gutter bolt	10	1.0	7.5
Final gear bolt	90	9.0	65.0
Reverse gear shift lever bolt	23	2.3	17.0
Transaxle case bolt	23	2.3	17.0
Reverse shaft bolt	23	2.3	17.0
Gear shift locating bolt	13	1.3	9.5
Left case plate bolt	23	2.3	17.0
Counter shaft nut	100	10.0	75.0
Side cover bolt	10	1.0	7.5
Gear shift guide case bolt	23	2.3	17.0
Shift fork bolt	10	1.0	7.5

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Fastening part	Tightening torque		
	N•m	kg-m	lb-ft
Gear shift interlock bolt	23	2.3	17.0
5th to reverse interlock guide bolt	23	2.3	17.0
Back up lamp switch	23	2.3	17.0
Gear shift control lever assembly mounting nut	13	1.3	9.5
Cable lock nut	5.5	0.55	4.0
Cable mounting bolt	10	1.0	7.5
Cable bracket bolt	55	5.5	42.0
Transaxle to engine bolt	85	8.5	64.0
Engine left mounting bracket bolt	55	5.5	42.0
Stiffener bolt	10	1.0	7.5
Engine rear mounting No.1 bolt	55	5.5	42.0
Engine rear mounting No.2 bracket bolt	55	5.5	42.0
Transaxle to engine rear mounting No.2 bracket bolt	55	5.5	42.0
Transaxle to engine nut	85	8.5	64.0
Clutch housing lower plate bolt	55	5.5	42.0
VSS bolt	5.5	0.55	4.0
Select lever bracket bolt	23	2.3	17.5
Side bearing retainer bolt	23	2.3	17.0
Engine rear mounting No.2 bolt	55	5.5	42.0
Rear mounting member bolt	55	5.5	42.0

Required Service Material

Material	Recommended SUZUKI product (Part Number)	Use
Lithium grease	SUZUKI SUPER GREASE A (99000-25010)	• Oil seal lips • O-rings • Select lever boss • Select lever shaft bush
Sealant	SUZUKI BOND NO. 1217G (99000-31260)	• Oil drain plug and filler/level plug • Gear shift locating bolt • Mating surface of transaxle case • Mating surface of side cover • Gear shift interlock bolt • 5th to reverse interlock guide bolt • Guide case bolt
Thread lock cement	THREAD LOCK 1322 (99000-32110)	• Reverse gear shift lever bolt • Oil gutter bolt • Reverse shaft bolt • Final gear bolt • Left case plate bolt • Shift fork bolt

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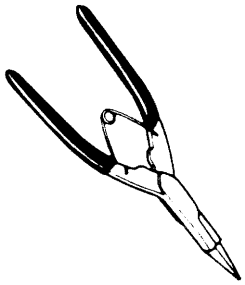
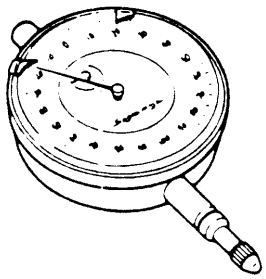
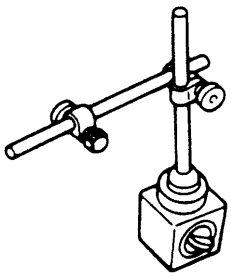
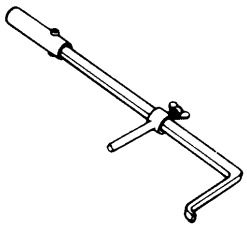
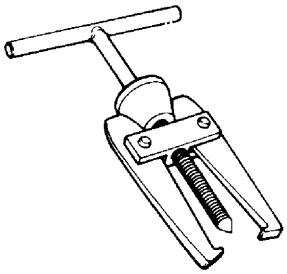
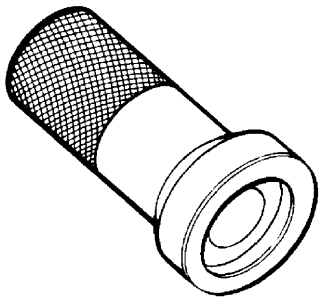
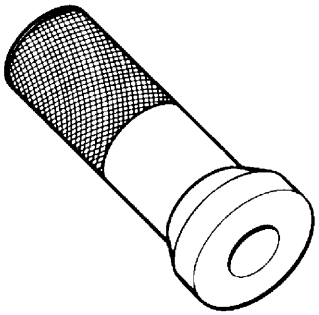
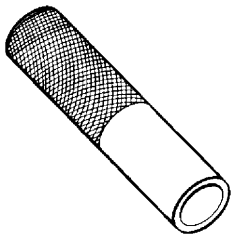
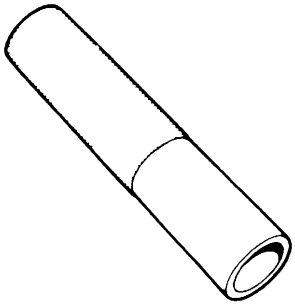
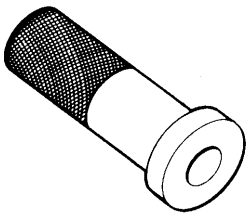
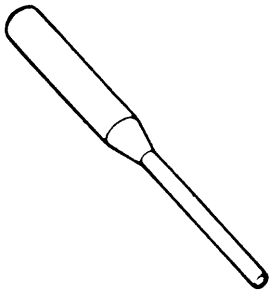
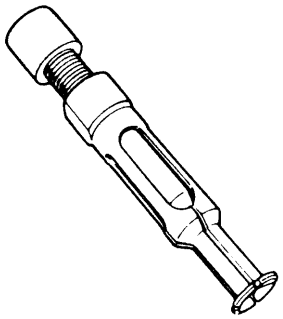
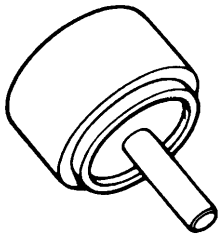
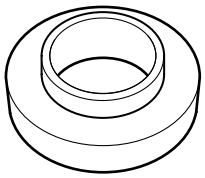
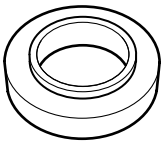
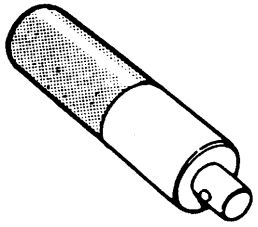
Special Tool

 09900-06107 Snap ring pliers (Opening type)	 09900-20606 Dial gauge	 09900-20701 Magnetic stand	 09913-50121 Oil seal remover
 09913-60910 Bearing puller	 09913-70123 Bearing installing tool	 09913-76010 Differential bearing race installer	 09913-80113 Bearing installer
 09913-84510 Bearing installer	 09913-85210 Bearing pulling holder	 09922-85811 Spring pin remover 4.5 mm (0.18 in.)	 09923-74510 Bearing remover
 09923-78210 Bearing installer	 09924-07710 Synchronizer hub, installer	 09924-07730 Bearing installer	 09924-74510 Installer attachment

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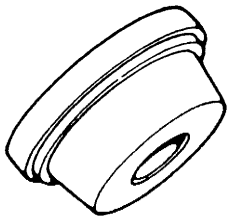
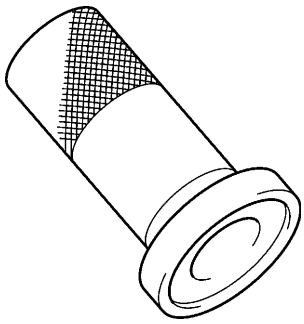
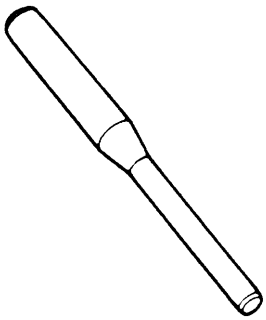
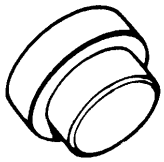
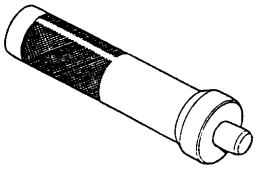
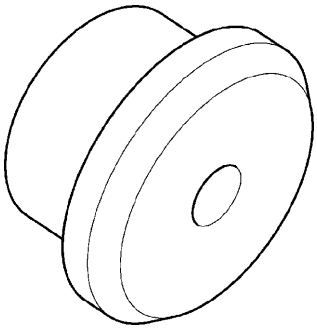
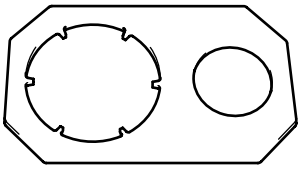
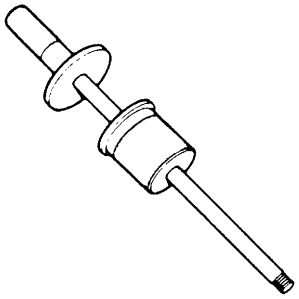
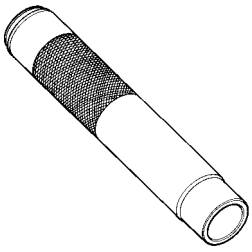
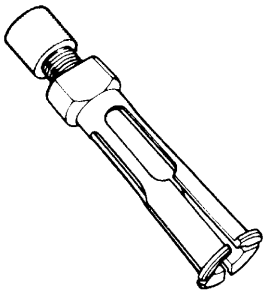
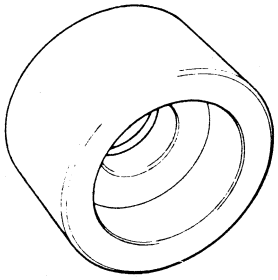
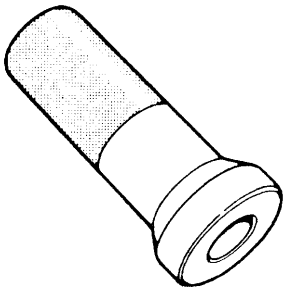
 09924-84510-004 Installer, bearing	 09925-15410 Oil seal installer	 09925-78210 Spring pin remover 6 mm (0.24 in.)	 09925-88210 Bearing puller attachment
 09925-98210 Installer, input shaft bearing	 09926-27610 Oil seal installer	 09927-76060 Gear holder	 09930-30104 Sliding shaft
 09940-51710 Bearing, installer	 09940-54910 Sensor rotor installer	 09941-64511 Bearing remover	 09951-16060 Bush remover
 09951-16080 Installer, bearing			

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SECTION 7D

TRANSFER

NOTE:

- **Refer to the same section of the Service Manual mentioned in the FOREWORD of this manual for all of this section except the following.**
- **Use the SUZUKI BOND NO. 1217G (99000-31260) instead of the SUZUKI BOND NO. 1216B (99000-31230) which is instructed in the same section of the Service Manual mentioned in "FOREWORD" of this Manual.**

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SECTION 8

BODY ELECTRICAL SYSTEM

WARNING:

For vehicles equipped with Supplemental Restraint (Air Bag) System :

- **Service on and around the air bag system components or wiring must be performed only by an authorized SUZUKI dealer. Refer to "Air Bag System Components and Wiring Location View" under "General Description" in air bag system section in order to confirm whether you are performing service on or near the air bag system components or wiring. Please observe all WARNINGS and "Service Precautions" under "On-Vehicle Service" in air bag system section before performing service on or around the air bag system components or wiring. Failure to follow WARNINGS could result in unintentional activation of the system or could render the system inoperative. Either of these two conditions may result in severe injury.**
- **Technical service work must be started at least 90 seconds after the ignition switch is turned to the "LOCK" position and the negative cable is disconnected from the battery. Otherwise, the system may be activated by reserve energy in the Sensing and Diagnostic Module (SDM).**

NOTE:

For the items with asterisk (*) in the "CONTENTS" below, refer to the same section of the Service Manual mentioned in "FOREWORD" of this manual.

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Diagnosis

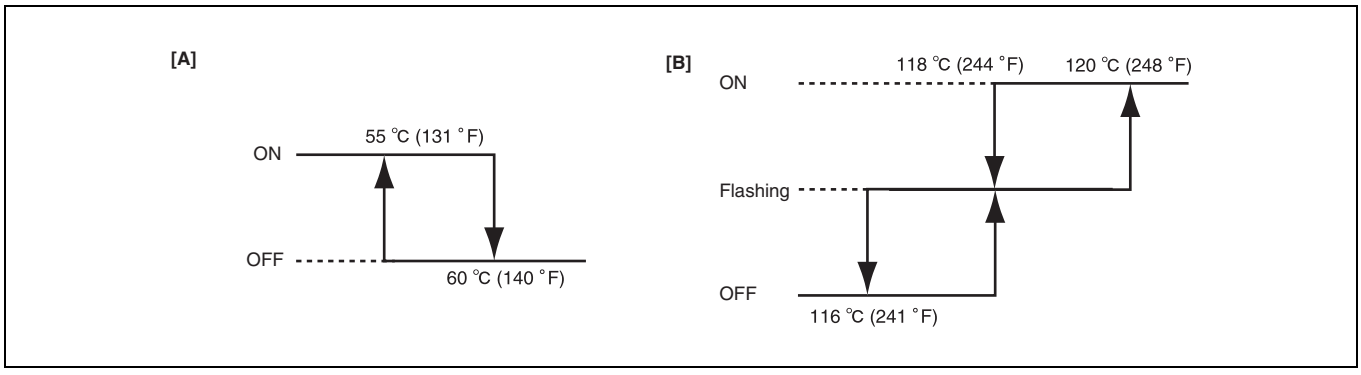
Turn Signal and Hazard Warning Lights

Condition	Possible Cause	Correction
Flash rate high or one side only flashes	Bulb blown on “flash rate high”-side	Replace bulb.
	Incorrect bulb	Replace bulb.
	Turn signal and hazard warning relay faulty	Check system referring to “Turn Signal and Hazard Warning Lights System” in this section.
	Wiring or grounding faulty	
Flash rate low	Supply voltage low	Check charging system.
	Turn signal and hazard warning relay faulty	Check system referring to “Turn Signal and Hazard Warning Lights System” in this section.
One side only flashes	Turn signal switch faulty	Check system referring to “Turn Signal and Hazard Warning Lights System” in this section.
	Turn signal and hazard warning relay faulty	
	Wiring or grounding faulty	
No flashing	“HORN HAZARD” fuse and/or “METER” fuse(s) blown	After checking short circuit, replace “HORN HAZARD” fuse and/or “METER” fuse.
	Turn signal and hazard warning relay faulty	Check system referring to “Turn Signal and Hazard Warning Lights System” in this section.
	Combination switch or hazard switch faulty	
	Wiring or grounding faulty	

Low Engine Coolant Temperature Light and High Engine Coolant Temperature Warning Light (Sport Model)

NOTE:

The low engine coolant temperature light and the high engine coolant temperature warning light come ON or flash when the specified engine coolant temperature below is detected by ECT sensor.



[A] : Low engine coolant temperature light operation
[B] : High engine coolant temperature warning light operation

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Condition	Possible Cause	Check or Correct
Low engine coolant temperature light and/or high engine coolant temperature warning light does not come ON after ignition switch turns to ON position	Combination meter internal circuit faulty	Replace combination meter.
	Wiring or grounding faulty	Repair.
Low engine coolant temperature light comes ON steady or flashing	Engine coolant is lower than specified	–
	Combination meter internal circuit faulty	Replace combination meter.
	ECT sensor faulty	Check ECT sensor referring to "Engine Coolant Temperature Sensor (ECT sensor) Inspection" in Section 6E2.
	ECT signal from ECM faulty	Check Engine Coolant Temp. Signal for Combination meter" referring to "Inspection of ECM and Its Circuits:" in Section 6-1.
	Wiring or grounding faulty	Repair.
High engine coolant temperature light comes ON steady or flashing	Engine coolant is excessive high temperature	Cool engine off
	Combination meter internal circuit faulty	Replace combination meter.
	ECT sensor faulty	Check ECT sensor referring to "Engine Coolant Temperature Sensor (ECT sensor) Inspection" in Section 6E2.
	ECT signal from ECM faulty	Check Engine Coolant Temp. Signal for Combination meter referring to "Inspection of ECM and Its Circuits:" in Section 6-1.
	Wiring or grounding faulty	Repair.

Power Door Lock System without Keyless Entry System (If Equipped)

Condition	Possible Cause	Correction
All are not locked/unlocked by only driver side key cylinder switch	"DOOR LOCK" fuse blown	After checking short circuit, replace "DOOR LOCK" fuse.
	Driver side door knob switch faulty	Check system referring to "Power Door Lock System without Keyless Entry System" in this section.
	Power door lock controller faulty	
	Wiring or grounding faulty	
Only one door is not locked/unlocked	Power door lock actuator faulty	Check system referring to "Power Door Lock System without Keyless Entry System" in this section.
	Wiring or grounding faulty	

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Power Door Lock System with Keyless Entry System (If Equipped)

Condition	Possible Cause	Correction
All are not locked/ unlocked by only driver side key cylinder switch	"DOOR LOCK" fuse blown	After checking short circuit, replace "DOOR LOCK" fuse.
	Driver side door knob switch faulty	Check system referring to "Power Door Lock System without Keyless Entry System" in this section.
	Power door lock controller faulty	
	Wiring or grounding faulty	
Only one door is not locked/unlocked	Power door lock actuator faulty	Check system referring to "Power Door Lock System without Keyless Entry System" in this section.
	Wiring or grounding faulty	
All doors are not locked/unlocked by only keyless entry transmitter	Transmitter battery dead	Replace battery.
	Transmitter faulty	Replace transmitter.
	Code registration error	Perform code registration referring to "Transmitter Code Registration Procedure" in this section.
	Door switch faulty	Check system referring to "Power Door Lock System without Keyless Entry System" in this section.
	Key remainder switch (in ignition switch) faulty	
	Power door lock controller faulty	
	Wiring or grounding faulty	
Turn signal lights are not flashed when doors are locked/ unlocked by transmitter	Keyless entry system is in interior light signal mode	Change signal mode referring to "Change of Signal Mode" in this section.
	Turn signal and hazard warning system faulty	Check system referring to "Turn Signal and Hazard Warning Lights System" in this section.
	Power door lock controller faulty	Check system referring to "Power Door Lock System with Keyless Entry System" in this section.
	Wiring or grounding faulty	
Interior light does not turn ON when interior light switch is at DOOR position and doors are unlocked by transmitter	Power door lock controller faulty	Check system referring to "Power Door Lock System with Keyless Entry System" in this section.
	Wiring or grounding faulty	

Door Mirror Heater (If Equipped)

Condition	Possible Cause	Correction
All door mirrors mist when rear defogger switch is ON	"CIGAR" fuse blown	After checking short circuit, replace fuse.
	Rear defogger switch faulty	Check switch.
	Wiring or grounding faulty	Repair circuit.
	Door mirror heater relay faulty	Check relay
One mirror mists when rear defogger switch is ON	Mirror heater faulty	Check mirror heater.
	Wiring or grounding faulty	Repair circuit.

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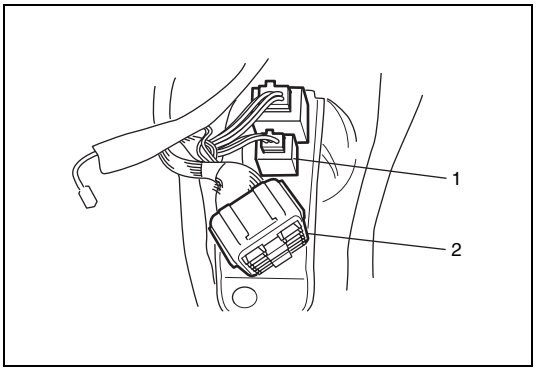
On-Vehicle Service

Turn Signal and Hazard Warning Lights System

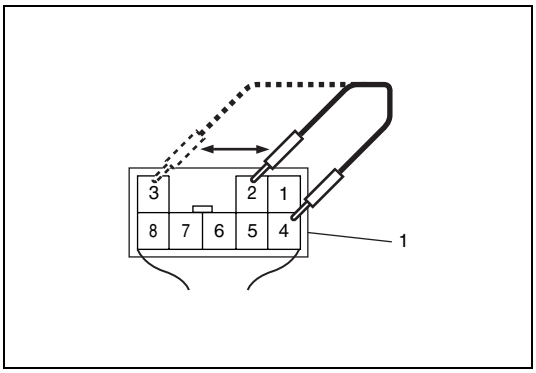
Turn signal and hazard warning lights system circuit inspection



1) Disconnect negative (–) cable from battery.
2) Disconnect turn signal and hazard warning relay (1) connector “G42”.

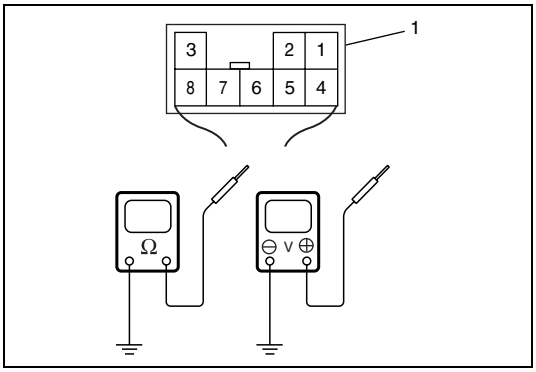
2: Fuse box

3) Connect negative (–) cable to battery.



4) Confirm that right or left side turn signal light turn on when connect “G42-4” terminal to “G42-2” or “G42-3” terminal with service wire.
   If turn signal light does not turn on, check bulb or repair applicable circuit.

1: Turn signal and hazard warning relay connector “G42” viewed from harness side



5) Check that voltage and continuity between the following terminals and body ground are specifications under each condition.
   If check result is not as specified, repair applicable circuit.
   If check result is OK, replace turn signal and hazard warning relay and recheck.

1: Turn signal and hazard warning relay connector “G42” viewed from harness side

Turn Signal and Hazard Warning Lights System Circuit Check

Terminal	Wire	Circuit	Specification	Condition
G42-1	BLU	Ignition switch circuit	10 – 14 V	Ignition switch is ON position.
			0 – 1 V	Ignition switch is ON position.
G42-4	GRN/WHT	Power supply for turn signal and hazard warning lights	10 – 14 V	–
G42-5	BLU/RED	Right side turn signal light switch circuit	Continuity	Turn signal light switch is R position.
			No continuity	Turn signal light switch is N or L position.

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Terminal	Wire	Circuit	Specification	Condition
G42-6	GRN/YEL	Left side turn signal light switch circuit	Continuity	Turn signal light switch is L position.
			No continuity	Turn signal light switch is N or R position.
G42-7	BLK	Ground	0 – 1 V	–
G42-8	YEL/RED	Hazard warning switch and keyless entry system (if equipped) circuits	Continuity	Hazard warning switch is ON position.
				Approx. 1.2 sec. after pushing UNLOCK button on transmitter.
				Approx. 0.6 sec. after pushing LOCK button on transmitter.
			No continuity	Driver side door knob switch is lock position.

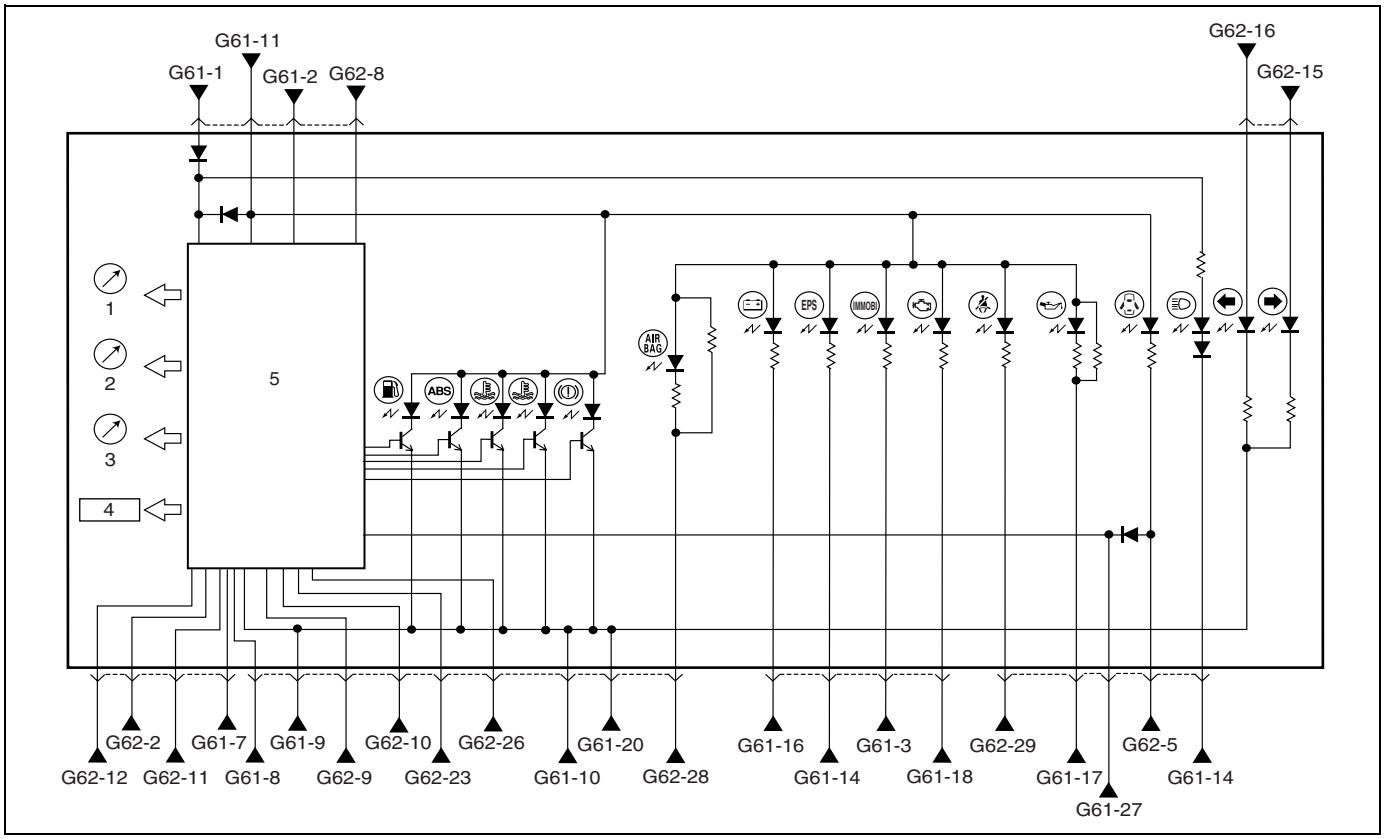
Combination Meter

Circuit

Except Sport Model

Refer to the some section of the Service Manual mentioned in “FOREWORD” of this manual.

Sport model



1. Speedometer	3. Fuel level meter	5. CPU
2. Tachometer	4. Buzzer unit	

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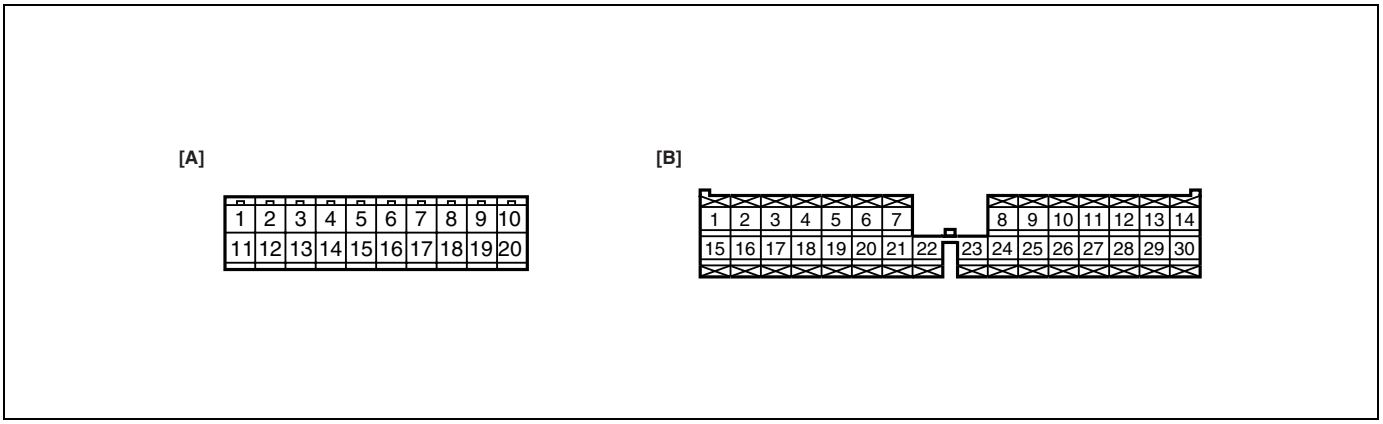
Terminal arrangement of combination meter connector viewed from harness side



[A]: Connector “G61”
[B]: Connector “G62”

Terminal G61	Wire Color	Circuit
G61-1	WHT/RED	To “RADIO DOME” fuse (power supply)
G61-2	RED/YEL	To lighting switch (illumination control signal)
G61-3	PNK	To ECM (immobilizer indicator control signal) (if equipped)
G61-4	–	–
G61-5	–	–
G61-6	–	–
G61-7	BLU	To data link connector (DLC)
G61-8	YEL/RED	To fuel level gauge
G61-9	BLK/ORN	To fuel level gauge ground
G61-10	BLK	To engine ground
G61-11	BLU	To “METER” fuse (ignition ON signal)
G61-12	–	–
G61-13	–	–
G61-14	YEL	To EPS control module (EPS indicator control signal)
G61-15	–	–
G61-16	WHT/BLU	To generator (charge warning indicator control signal)
G61-17	YEL/BLK	To oil pressure switch
G61-18	PPL/WHT	To ECM (MIL control signal)
G61-19	–	–
G61-20	BLK	To body ground

Terminal G62	Wire Color	Circuit
G62-1	–	–
G62-2	WHT/GRN	To ECM (engine coolant temperature indicator control signal)
G62-3	–	–
G62-4	–	–
G62-5	BLK/YEL	To door switch (except driver side)
G62-6	–	–
G62-7	–	–
G62-8	BLU/YEL	To “RADIO DOME” fuse (key remainder signal)
G62-9	RED/BLU	To ABS control module (ABS indicator control signal)
G62-10	PNK/BLU	To ABS control module (EBD indicator control signal)
G62-11	PPL	To VSS (speedometer signal)

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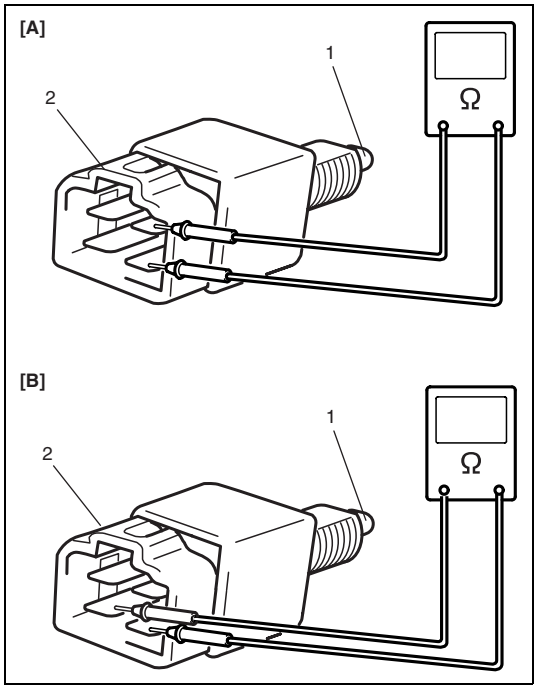
Terminal G62	Wire Color	Circuit
G62-12	BRN	To ECM (tachometer signal)
G62-13	–	–
G62-14	RED	To combination switch (high beam indicator control signal)
G62-15	BLU/YEL	To combination switch (turn R signal indicator control signal)
G62-16	GRN/RED	To combination switch (turn L signal indicator control signal)
G62-17	–	–
G62-18	–	–
G62-19	–	–
G62-20	–	–
G62-21	–	–
G62-22	–	–
G62-23	WHT/GRN	To parking brake switch
G62-24	–	–
G62-25	–	–
G62-26	RED/BLK	To brake fluid level switch
G62-27	GRN	To door switch (driver side)
G62-28	YEL/RED	To SDM (AIR BAG indicator control signal)
G62-29	BRN	To seat belt switch
G62-30	–	–

Stop Lamp (Brake) Switch

Inspection

TYPE 1



1) Distinguish type A from type B switch by connector (2) color.
2) Check stop lamp (brake) switch for continuity as shown in figure.
   If malfunction is found, replace stop lamp (brake) switch.

Stop lamp (brake) switch specification
Switch slider (1) pushed: No continuity
Switch slider (1) released: Continuity

[A]: Type A (Black connector)
[B]: Type B (Blue connector)

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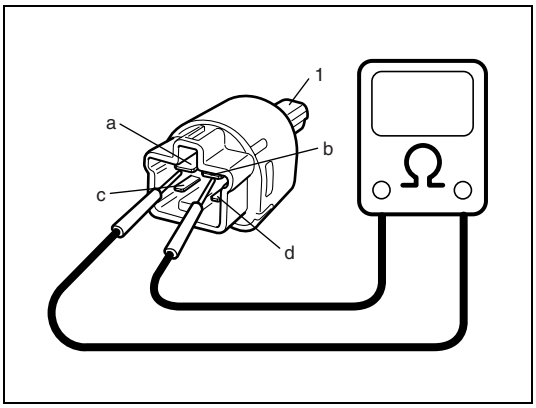
TYPE 2



1) Check stop lamp (brake) switch for continuity as shown in figure.
   If malfunction is found, replace stop lamp (brake) switch.

Stop lamp (brake) switch specification
Between “a” and “b” for stop lamp circuit.
Switch slider (1) pushed: No continuity
Switch slider (1) released: Continuity
Between “c” and “d” for A/T shift lock circuit.
Switch slider (1) pushed: Continuity
Switch slider (1) released: No continuity

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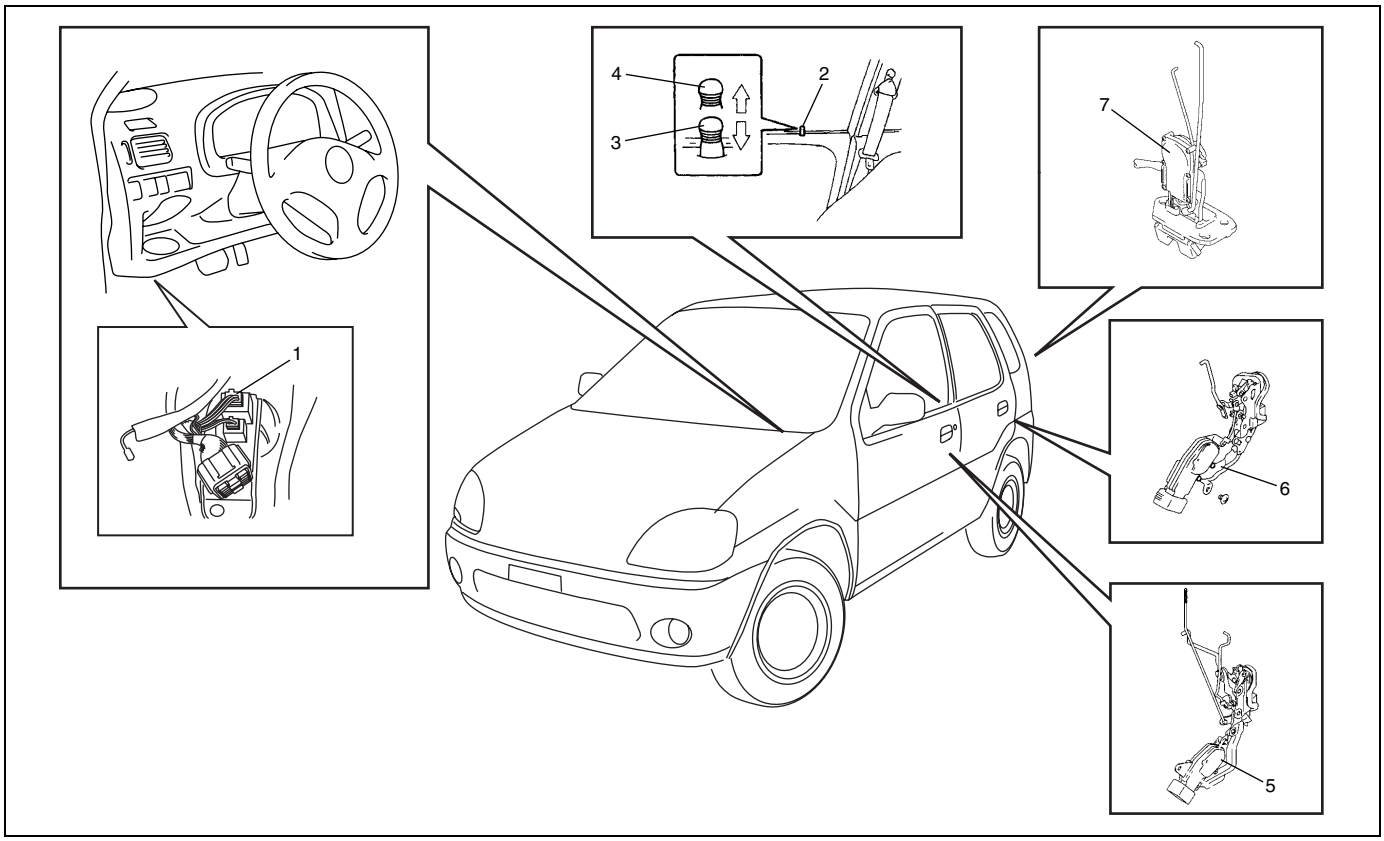
Power Door Lock System without Keyless Entry System (If Equipped)

Component location of power door lock system without keyless entry system



1. Power door lock controller	3. LOCK position	5. Front door actuator	7. Back door actuator
2. Driver side door knob switch	4. UNLOCK position	6. Rear door actuator (5 door model)	

Power door lock system operation inspection

1) Check the following operation:
   a) When the driver side key cylinder is turned LOCK, check all doors lock.
   b) When the driver side door key cylinder is turned UNLOCK, check all doors unlock.

If check result is not satisfied, go to “Power Door Lock System Circuit Inspection” in this section.

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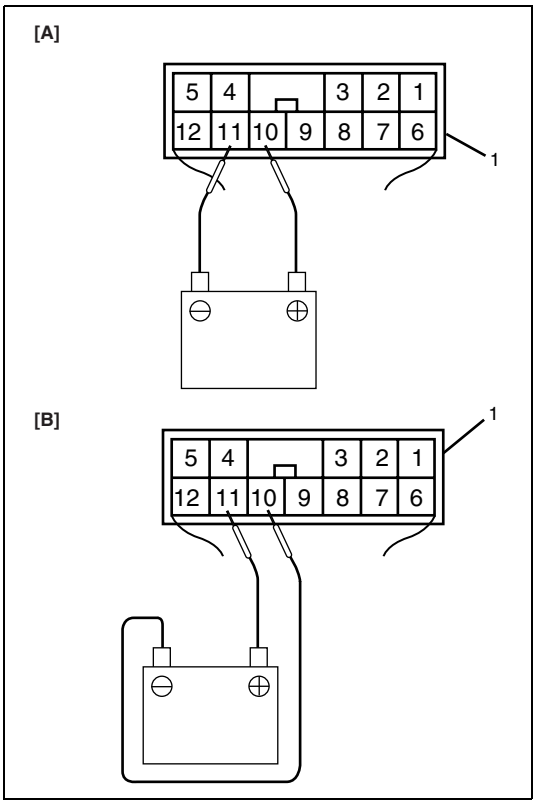
Power door lock system circuit inspection

1) Disconnect negative cable from battery.
2) Disconnect door lock controller coupler (1).
3) Confirm that all doors are unlocked. Connect battery positive (+) and negative (–) terminals to door lock controller coupler terminals and check power door lock operation as follows.
   If it does not operate as specified, repair applicable circuit or check actuator. If it operates as specified, go to next step.

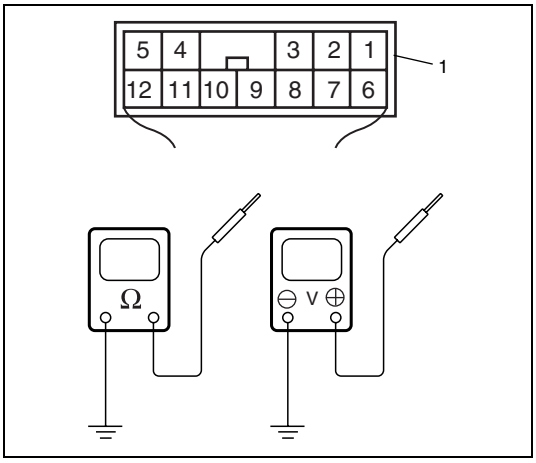
Power door lock operation for vehicle:

Step	TERMINAL		OPERATION
	G40-10	G40-11	
1	⊕	⊖	UNLOCK ⟶ LOCK
2	⊖	⊕	LOCK ⟶ UNLOCK



[A]: Step 1: Lock operation check
[B]: Step 2: Unlock operation check
1. Power door lock controller coupler “G40” viewed from harness side

4) Connect negative (–) cable to battery.
5) Check that the voltage and continuity between the following terminals and body ground are specifications under each conditions.
   If check result is not as specified, repair circuit.
   If check result is OK, recheck power door lock system as follows.
   a) Substitute a known-good door lock controller.
   b) Recheck power door lock system circuit.



1: Power door lock controller coupler “G40” viewed from harness side

Power Door Lock System Circuit Check

Terminal	Wire	Circuit	Specification	Condition
G40-7	WHT/GRN	Main power supply	10 – 14 V	–
G40-8	BRN	Driver side door knob switch lock signal circuit	Continuity	Driver side door knob switch is lock position.
			No continuity	Driver side door knob switch is unlock position.
G40-9	BRN/WHT	Driver side door knob switch unlock signal circuit	Continuity	Driver side door knob switch is unlock position.
			No continuity	Driver side door knob switch is lock position.
G40-12	BLK	Ground	0 – 1 V	–

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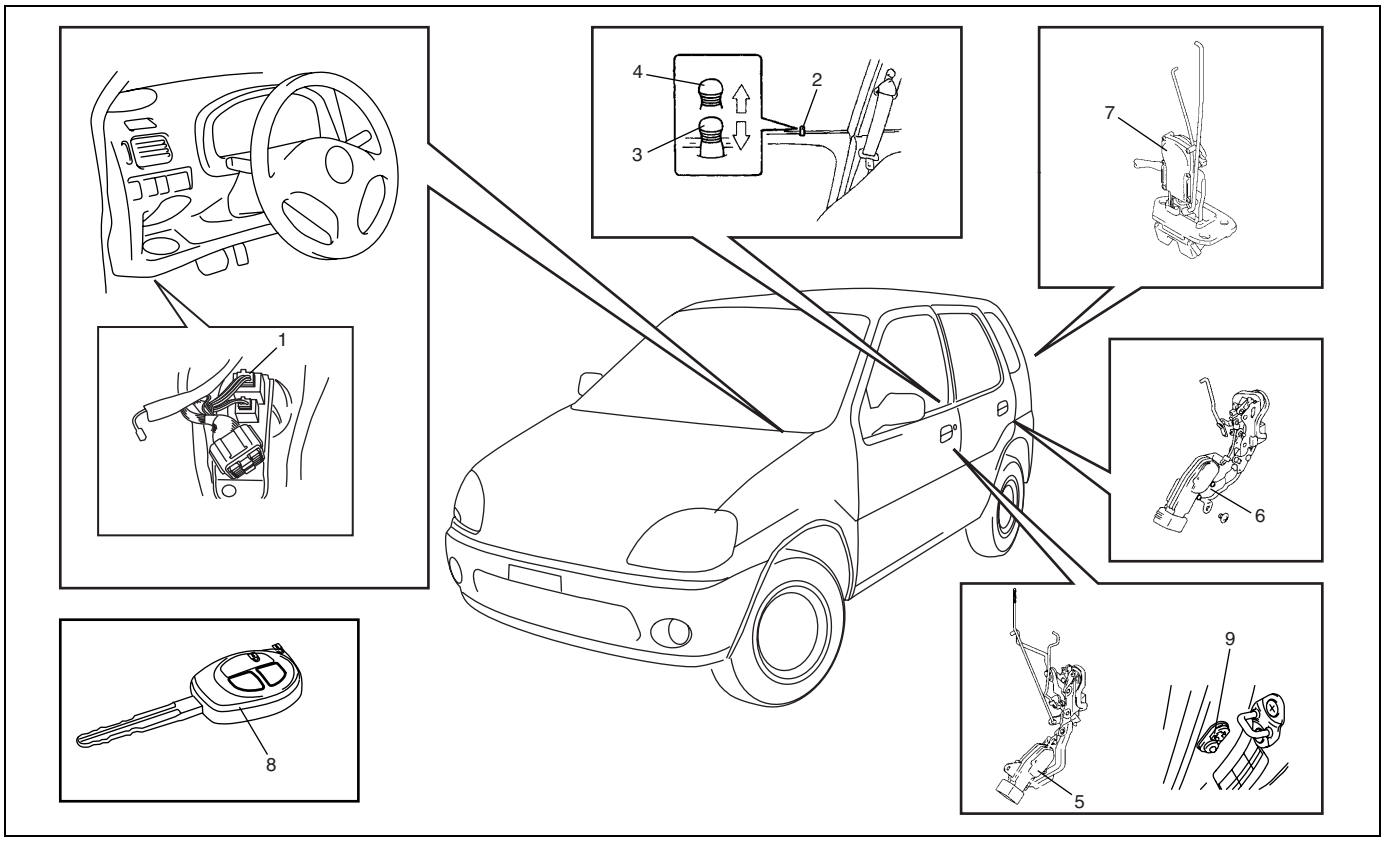
Power Door Lock System with Keyless Entry System (If Equipped)

Component location of power door lock system with keyless entry system



1. Power door lock controller	4. UNLOCK position	7. Back door actuator
2. Driver side door knob switch	5. Front door actuator	8. Transmitter
3. LOCK position	6. Rear door actuator (5 door model)	9. Door switch

System description

The keyless entry system has the following signal modes in order to feed back the signal when the controller received LOCK and UNLOCK signals from transmitter.

	Received signal	
Signal mode	LOCK signal	UNLOCK signal
Hazard warning light signal mode	The hazard warning lights flash once.	The hazard warning lights flash twice and the interior light turns on about 15 seconds.
Interior light signal mode	The interior light flashes twice.	The interior light turns on about 15 seconds.

NOTE:

- **These signal modes are able to change referring to “Change of Signal Mode” in this section.**
- **The initial condition is the hazard warning light signal mode.**

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Change of signal mode

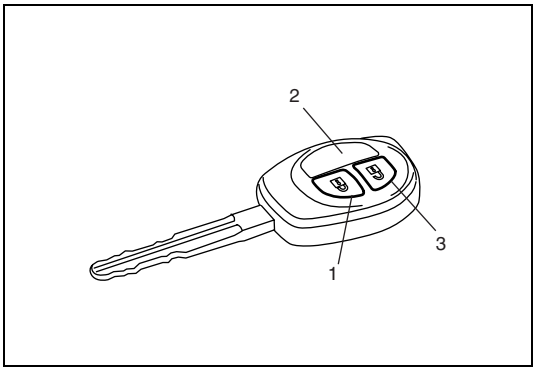
1) Confirm that all doors are closed and ignition key is out of ignition switch.
2) Perform the following procedures within 15 seconds.
   a) Insert ignition key to ignition switch and pull out ignition key from ignition switch.
   b) Repeat step a) two times.
   c) Insert ignition key to ignition switch, and then push “LOCK” button on transmitter more than five times.
3) Confirm that hazard warning light or interior light flash once. With this, change of signal mode is completed.

Keyless entry system operation inspection

NOTE:

If keyless entry system is in interior light signal mode, change to hazard warning light signal mode referring to “Change of Signal Mode” in this section.

1) Confirm that power door lock system is good condition referring to “Power Door Lock System Operation Inspection” in this section.
2) Confirm that turn signal and hazard warning light system is good condition referring to “Turn Signal and Hazard Warning Light System” in this section.
3) Check transmitter battery for dead. If battery is dead, replace battery referring to “Replacement of Transmitter Battery” under “Transmitter” in this section.
4) Confirm that all doors are closed and unlocked.



5) Check the following operation:
   a) When pushing “LOCK” button (1) on transmitter (2), check all doors lock and hazard warning lights flash once.
   b) When pushing “UNLOCK” button (3) on transmitter (2), check all doors unlock and hazard warning lights flash twice and interior light turn on about 15 seconds with the interior light switch in the middle position.

If check result is not satisfied, go to “Keyless Entry System Circuit Inspection” in this section.

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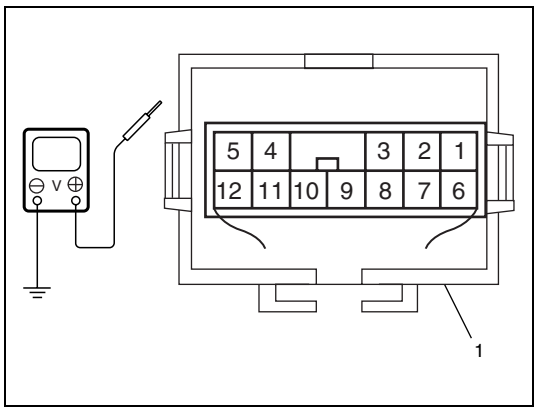
Keyless entry system circuit inspection

NOTE:

If keyless entry system is in interior light signal mode, change to hazard warning light signal mode referring to "Change of Signal Mode" in this section.



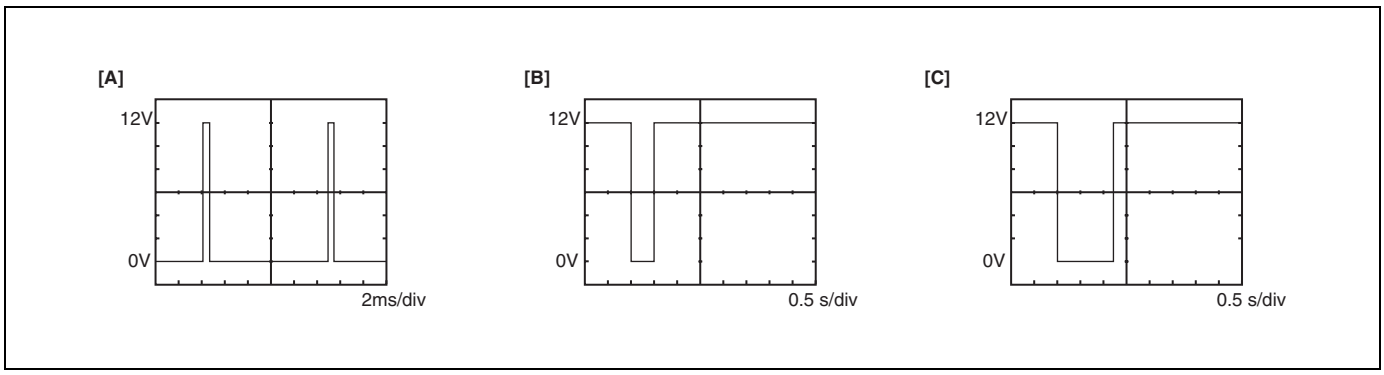
Check that the voltage and continuity between the following terminals and body ground are specifications under each conditions.
If check result is not as specified, check applicable circuit.
If circuit is normal, recheck keyless entry system circuit as follows.

1) Substitute a known-good door lock controller.
2) Register key code referring to "Transmitter Code Registration Procedure" in this section.
3) Recheck keyless entry system circuit.

1. Door lock controller

Keyless Entry System Circuit Check

Terminal	Wire	Circuit	Specification	Condition
G40-2	BLU/YEL	Key remainder circuit	10 – 14 V	Ignition key is in ignition switch.
			0 – 1 V	Ignition key is not in ignition.
G40-4	BLK/RED	Door switch & interior light circuit	0 – 1 V	Driver side, passenger side, rear driver side, rear passenger side or back door is open.
			10 – 14 V	All doors are close.
			Figure "A"	Fulfill the following conditions. • All door is close. • Interior light switch is middle position. • 15 seconds after pushing "UNLOCK" button on transmitter.
G40-5	YEL/RED	Hazard warning signal circuit	Figure "B"	Push "LOCK" button on transmitter.
			Figure "C"	Push "UNLOCK" button on transmitter.



[A]: Figure "A"
[B]: Figure "B"
[C]: Figure "C"

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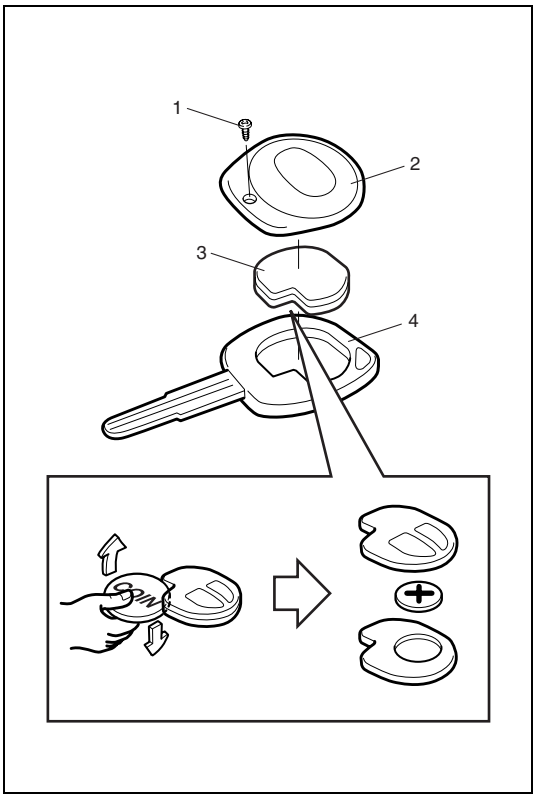
Transmitter

Replacement of Transmitter Battery

If transmitter becomes unreliable, replace transmitter battery as follows.



1) Remove screw (1), and remove cover (2) from ignition key (4).
2) Unhook tabs and remove transmitter (3).

CAUTION:
Use care not to allow grease or dirt to be attached on the printed circuit board and the battery.

3) Replace battery (lithium disc-type CR1616 or equivalent battery).
4) Set transmitter to cover (2).
5) Install cover (2) to ignition key (4) and tighten screw (1).
6) Make sure that keyless entry system can be operated with transmitter.

NOTE:

- **To prevent theft, be sure to break the transmitter before discarding it.**
- **Dispose of the used battery properly according to applicable rules or regulations. Do not dispose of lithium batteries with ordinary household trash.**

Transmitter code registration procedure

If transmitter or door lock controller replace new one, register key code as follows.

1) Confirm that the vehicle is the following conditions.
   - All doors are closed.
   - Ignition key is out of ignition switch.
   - Driver side door is unlocked and its window is opened.
2) Disconnect negative (–) cable from battery.
3) After 30 seconds, perform the following procedure within 60 seconds.
   a) Connect negative (–) cable to battery.
   b) Operate driver side door knob switch from lock to unlock twice.
   c) Push “LOCK” button on transmitter and confirm that all doors are operated from lock to unlock.
   d) Push driver side door knob switch to lock position.
   e) Push “LOCK” button on transmitter twice and confirm that all doors are operated from unlock to lock. With this, code registration is completed.

NOTE:

- **Two transmitter codes can be registered at the same time.**
- **When the three transmitter code is registered, the oldest one will be cleared automatically.**

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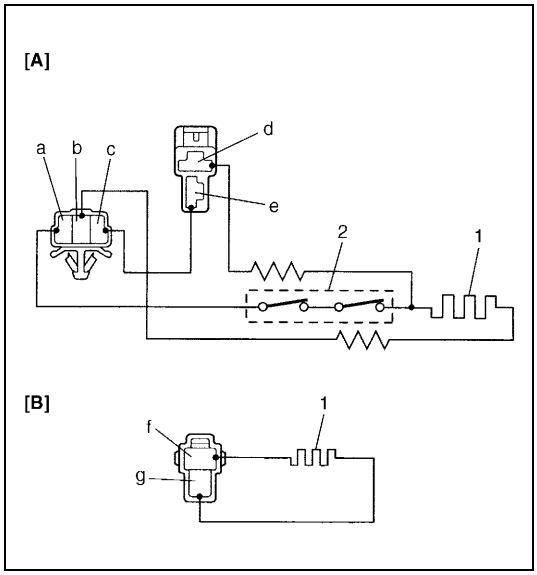
Seat Heater Wire

Inspection

TYPE 1



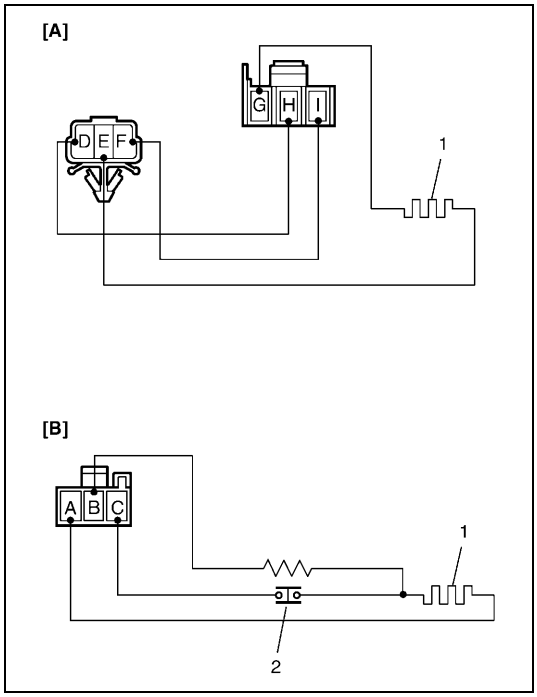
1) Confirm that seat heater switch is OFF position.
2) Disconnect two couplers of seat heater under the seat cushion.
3) Check for continuity between terminals as show below. If not continuity, replace faulty seat heater.

Seat heater circuit in seat back: [A]
Between "a" and "b"
Between "b" and "d"
Between "c" and "e"

Seat heater circuit in seat cushion: [B]
Between "f" and "g"

1. Heater wire
2. Thermostat

TYPE 2



1) Confirm that seat heater switch is OFF position.
2) Disconnect two couplers of seat heater under the seat cushion.
3) Check for continuity between terminals as show below. If not continuity, replace faulty seat heater.

Seat heater circuit in seat back: [A]
Between "D" and "H"
Between "E" and "G"
Between "F" and "I"

Seat heater circuit in seat cushion: [B]
Between "A" and "C"
Between "A" and "B"

1. Heater wire
2. Thermostat

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Door Mirror Heater (If Equipped)

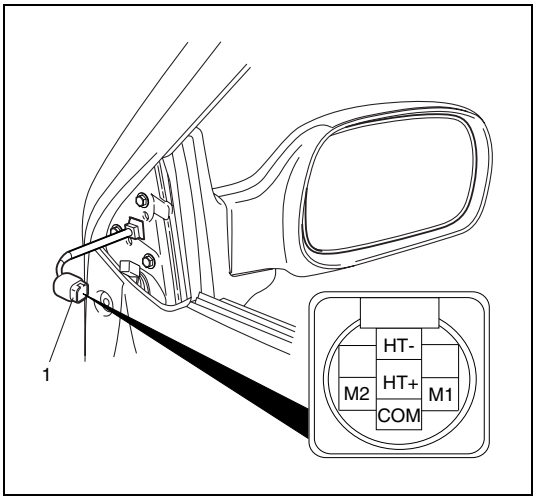
Mirror heater switch

Inspection

Door mirror heater switch is operated by rear window defogger switch. Check door mirror heater switch referring to “Rear Window Defogger” in this section.

Mirror heater

Inspection

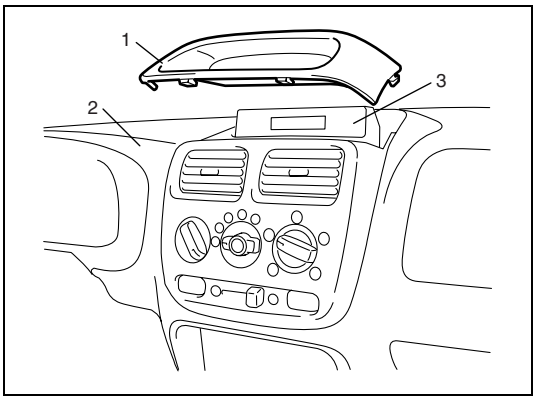


1) Remove garnish from door.
2) Disconnect door mirror coupler (1).

Check for continuity between terminals “HT+” and “HT–”. If not continuity, replace outside mirror.

Information Display Unit

Removal



1) Disconnect negative(-) cable at battery.
2) Remove center upper garnish trim (1) from instrument panel (2).
3) Remove mounting screws of information display unit.
4) Remove information display unit (3) from instrument panel (2).
5) Disconnect information display unit coupler.

Installation

Reverse removal procedure to install information display unit.

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SECTION 8G

IMMOBILIZER CONTROL SYSTEM

WARNING:

For vehicles equipped with a Supplemental Restraint (Air Bag) System

- **Service on and around the air bag system components or wiring must be performed only by an authorized SUZUKI dealer. Refer to "Air Bag System Components and Wiring Location View" under "General Description" in the air bag system section in order to confirm whether you are performing service on or near the air bag system components or wiring. Please observe all WARNINGs and "Service Precautions" under "On-Vehicle Service" in the air bag system section before performing service on or around the air bag system components or wiring. Failure to follow WARNINGs could result in unintentional activation of the system or could render the system inoperative. Either of these two conditions may result in severe injury.**
- **Technical service work must be started at least 90 seconds after the ignition switch is turned to the "LOCK" position and the negative cable is disconnected from the battery. Otherwise, the system may be activated by reserve energy in the Sensing and Diagnostic Module (SDM).**

NOTE:

For the items with asterisk (*) in the content below, refer to the same section of the service manual mentioned in the foreword of this manual.

8G

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General Description

The immobilizer control system designed to prevent vehicle burglar consists of following components.

- Engine Control Module (1) (ECM)
- Immobilizer Control Module (2) with coil antenna
- Ignition key (3) with built-in transponder

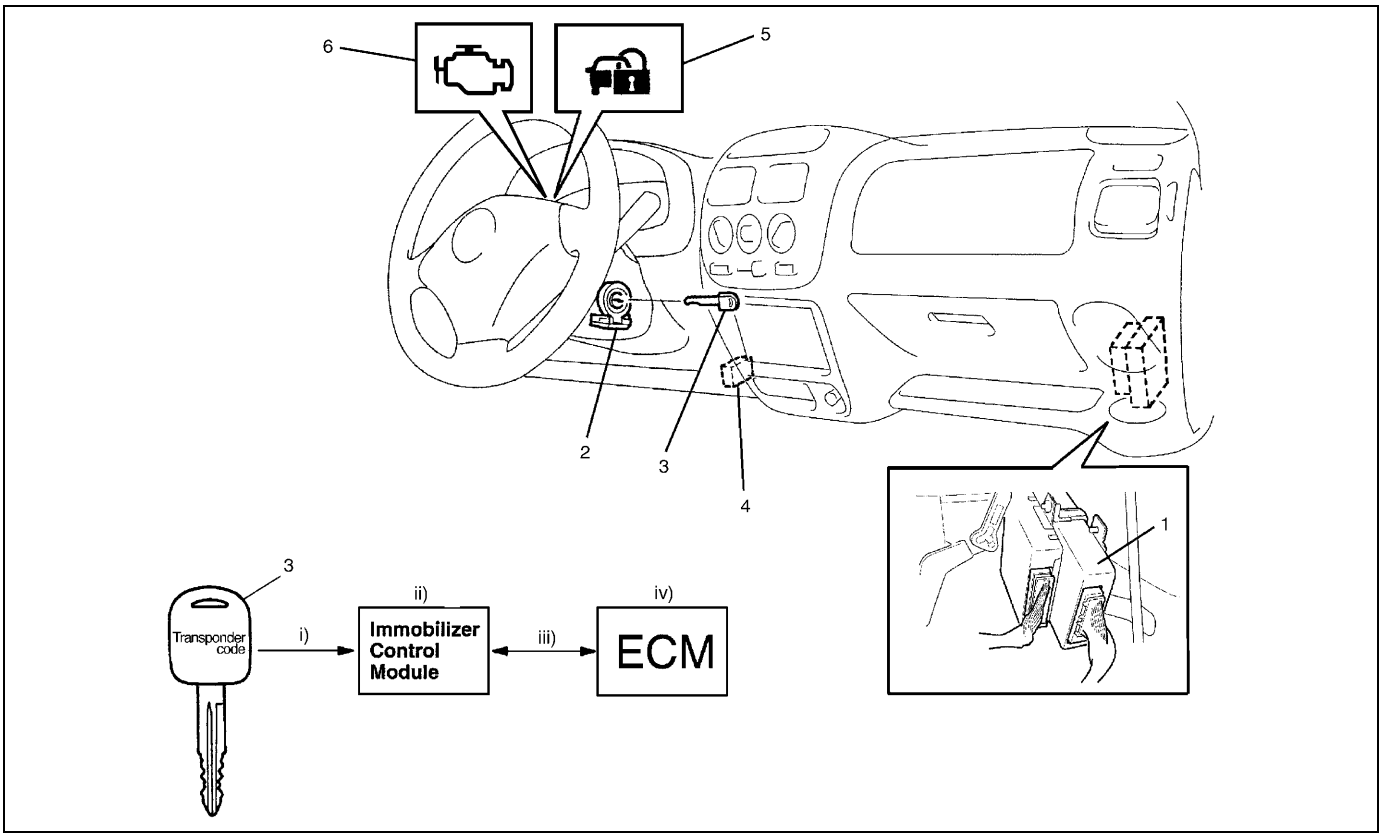
Operation of this system is as follows.

i) Each ignition key has its own code (Transponder code) stored in memory. When the ignition switch is turned ON, Immobilizer Control Module tries to read the Transponder code through the coil antenna installed to the steering lock assembly.

ii) Immobilizer Control Module compares the Transponder code read in Step (i) and that registered in Immobilizer Control Module and checks if they match.

iii) When it is confirmed that two Transponder codes match each other as described above, Immobilizer Control Module and ECM check if ECM/Immobilizer Control Module codes registered in them respectively match.

iv) Only when it is confirmed that ECM/Immobilizer Control Module codes match, the engine starts running. If Transponder codes in Step (ii) or ECM/Immobilizer Control Module codes in Step (iii) do not match, ECM will stop operation of the injector and ignition of spark plug.



4. Data link connector (DLC)
5. Immobilizer indicator lamp (if equipped)
6. Malfunction indicator lamp

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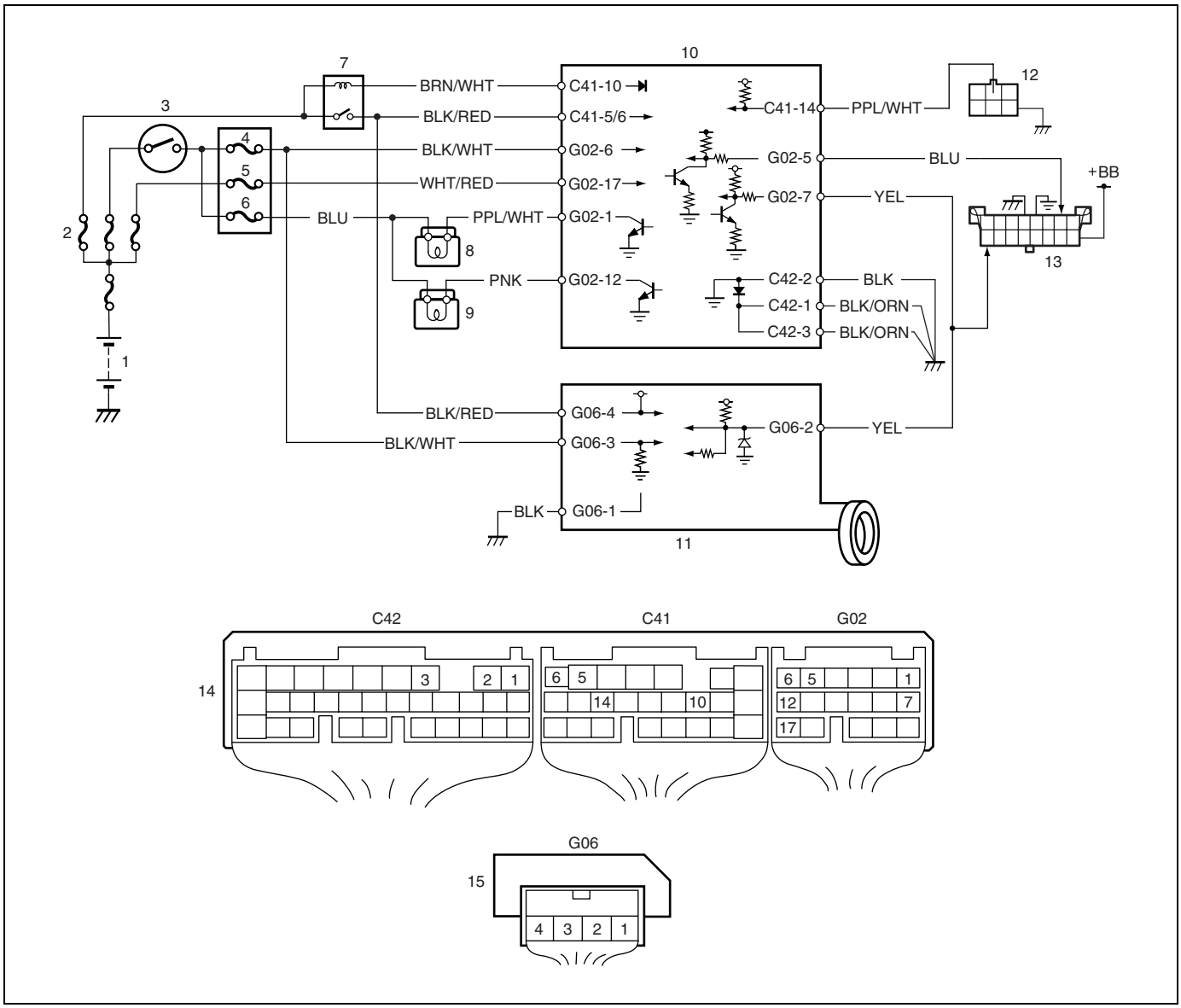
Wiring Circuit

Except Sports Model



1. Battery	6. “METER” fuse (10 A)	11. Immobilizer Control Module
2. Fuse	7. Main relay	12. Diagnosis connector (if equipped)
3. Ignition switch	8. Malfunction indicator lamp	13. Data link connector
4. “IG” fuse (15 A)	9. Immobilizer indicator lamp (if equipped)	14. ECM couplers (viewed from harness side)
5. “RADIO DOME” fuse (15 A)	10. ECM	15. Immobilizer control module coupler (viewed from harness side)

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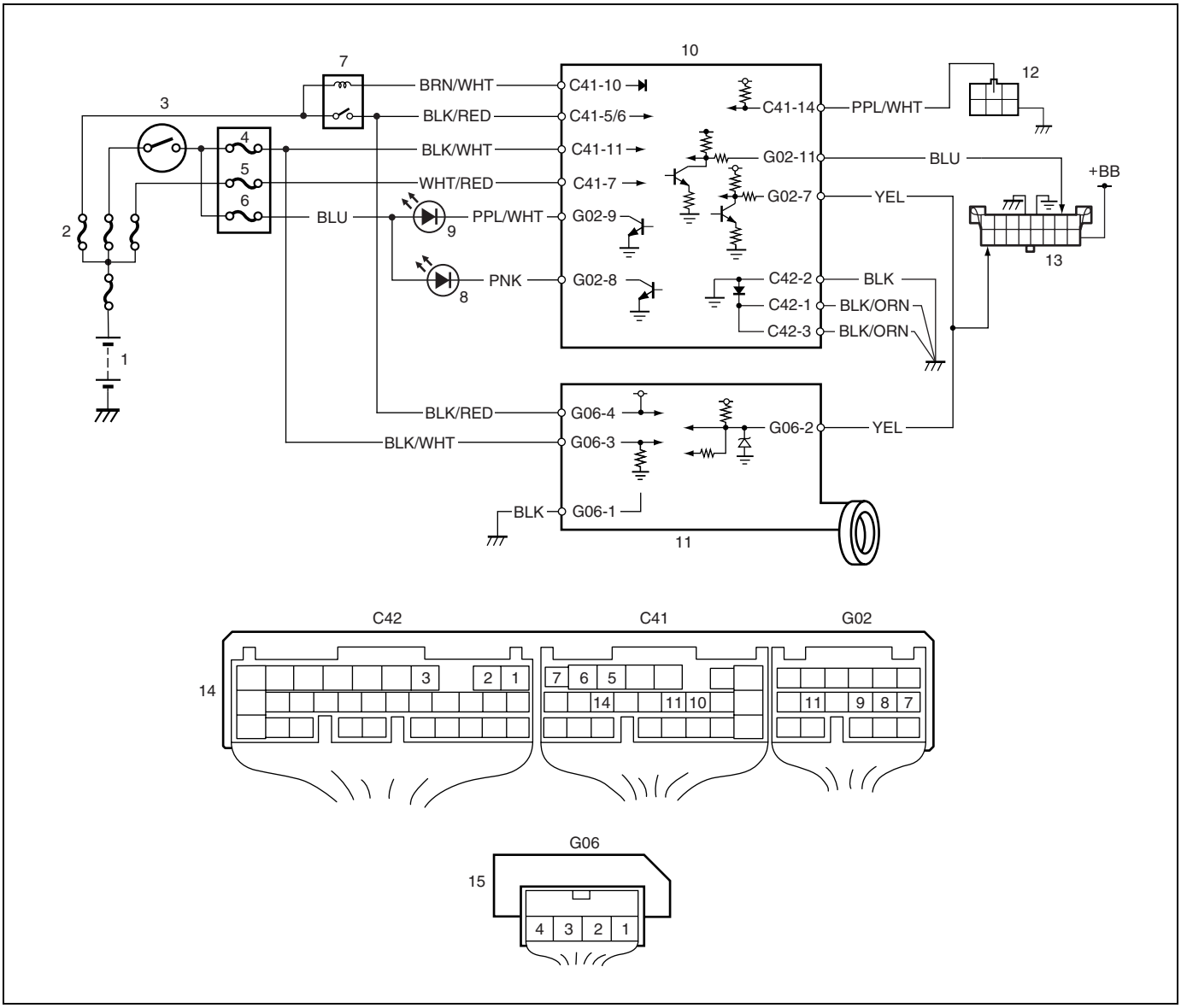
Sports Model



1. Battery	6. “METER” fuse (10 A)	11. Immobilizer Control Module
2. Fuse	7. Main relay	12. Diagnosis connector (if equipped)
3. Ignition switch	8. Malfunction indicator lamp	13. Data link connector
4. “IG” fuse (15 A)	9. Immobilizer indicator lamp (if equipped)	14. ECM couplers (viewed from harness side)
5. “RADIO DOME” fuse (15 A)	10. ECM	15. Immobilizer control module coupler (viewed from harness side)

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On-Board Diagnostic System (Self-Diagnosis Function)

Immobilizer Control Module and ECM diagnose troubles which may occur in the area including the following parts when the ignition switch is ON.

ECM:

- ECM/Immobilizer Control Module code
- Serial data link circuit
- ECM

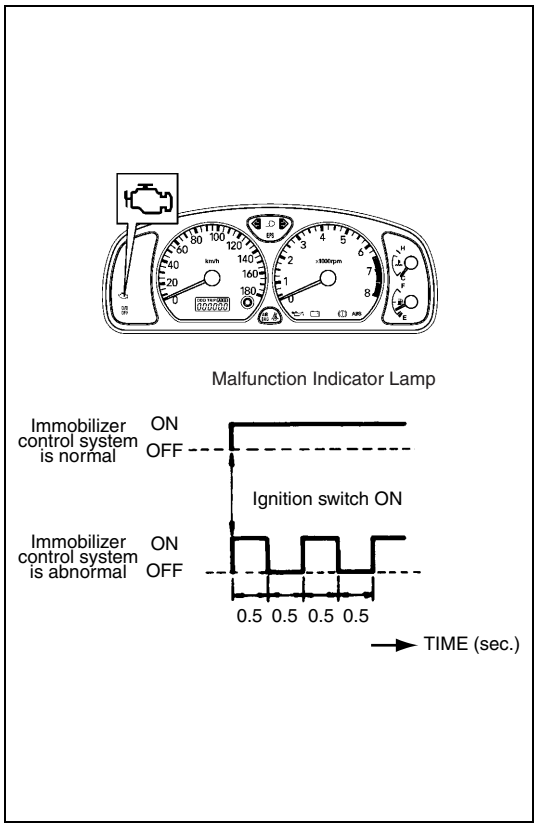
Immobilizer Control Module:

- Transponder code
- Coil antenna
- ECM/Immobilizer Control Module code
- Serial data link circuit
- Immobilizer Control Module
- Ignition signal

<Vehicle not equipped with immobilizer indicator lamp>

With the diagnosis switch terminal of diagnosis connector for ECM not grounded, the ignition switch turned ON (but the engine at stop) and regardless of the condition of the engine fuel injection system, ECM indicates whether a trouble has occurred in the immobilizer control system or not by causing the malfunction indicator lamp to flash or turn ON.

Malfunction indicator lamp is ON:
No trouble exists in the immobilizer control system.
Malfunction indicator lamp is flashing ON and OFF:
ECM or Immobilizer Control Module has detected some trouble in the immobilizer control system.



NOTE:

As soon as the ignition switch is turned ON, ECM and Immobilizer Control Module diagnose if a trouble has occurred in the immobilizer control system. While the diagnosis is being made, the malfunction indicator lamp stays ON and if the diagnosis result is "abnormal", it immediately changes to flashing but if the result is "normal", it remains ON. Diagnosis takes about 3 seconds at maximum.

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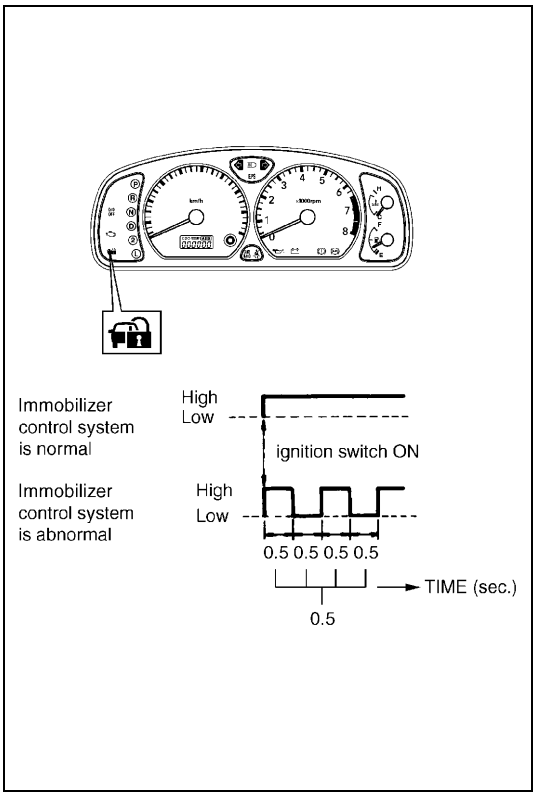

<Vehicle equipped with immobilizer indicator lamp>

With the ignition switch turned ON (but the engine at stop) regardless of the condition of the engine and emission control system, ECM indicates whether a trouble has occurred in the immobilizer control system or not by causing the immobilizer indicator lamp to flash or turn ON.

Immobilizer indicator lamp is ON:
No trouble exists in the immobilizer control system.
Immobilizer indicator lamp is flashing ON and OFF:
ECM or Immobilizer Control Module has detected some trouble in the immobilizer control system.

NOTE:

As soon as the ignition switch is turned ON, ECM and Immobilizer Control Module diagnose if a trouble has occurred in the immobilizer control system. While the diagnosis is being made, the immobilizer indicator lamp stays ON and if the diagnosis result is "abnormal", it immediately changes to flashing but if the result is "normal", it remains ON. Diagnosis takes about 3 seconds at maximum.

When ECM and Immobilizer Control Module detects a trouble, it stores DTC corresponding to the exact trouble area in ECM and Immobilizer Control Module memory.

DTCs stored in memory of each controller (Immobilizer Control Module and ECM) can be read by using the procedure described in "Diagnostic Trouble Code (DTC) Check (Immobilizer Control Module)" and "Diagnostic Trouble Code (DTC) Check (ECM)" in this section.

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Diagnosis

Precautions in Diagnosing Troubles

Precautions in identifying diagnostic trouble code

ECM

<Vehicle not equipped with immobilizer indicator lamp>

- Before identifying diagnostic trouble code indicated by malfunction indicator lamp or SUZUKI scan tool, don't disconnect couplers from ECM, battery cable from battery, ECM ground wire harness from engine.
  Such disconnection will clear trouble codes for engine and emission control system and immobilizer control system stored in memory of ECM.
- If abnormality or malfunction lies in two or more areas, malfunction indicator lamp indicates applicable codes three times each.
  And flashing of these codes is repeated as long as diagnosis terminal is grounded and ignition switch is held at ON position.
- When ECM detects a trouble in both engine and emission control system and immobilizer control system, malfunction indicator lamp indicates trouble codes of both systems alternately while the ignition switch is turned ON and the diagnosis terminal is grounded.
- Take a note of diagnostic trouble code indicated first.

<Vehicle equipped with immobilizer indicator lamp>

- Before identifying diagnostic trouble code indicated through SUZUKI scan tool, don't disconnect couplers from ECM, battery cable from battery, ECM ground wire harness from engine.
  Such disconnection will clear trouble codes for engine and emission control system and immobilizer control system stored in memory of ECM.
- Take a note of diagnostic trouble code indicated first.

Immobilizer Control Module

- Take a note of diagnostic trouble code indicated first.

Intermittent Troubles

- There is case where SUZUKI scan tool indicate a diagnostic trouble code representing a trouble which occurred only temporarily and has gone. In such case, it may occur that good parts are replaced unnecessarily. To prevent such accident, be sure to follow instructions given below when checking by using "Diagnostic Flow Table".
  - When trouble can be identified, it is not an intermittent one:
    Check coil antenna, ignition key, wires and each connection and if they are all in good condition, substitute a known-good ECM and recheck.
  - When trouble can not be identified but SUZUKI scan tool indicate a trouble code:
    Diagnose trouble by using that code No. and if ignition key, coil antenna, wires and each connection are all in good condition, turn OFF ignition switch and then ON.

Then check what SUZUKI scan tool indicate. Only when they indicate trouble code again, substitute a known-good ECM or Immobilizer Control Module and check again.
If they indicate not trouble code but normal code, it means that an intermittent trouble did occur and has gone. In this case, check wires and connections carefully again.

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Diagnostic Flow Table

<Vehicle not equipped with immobilizer indicator lamp>

Step	Action	Yes	No
1	1) Make sure that diagnosis switch terminal in diagnosis connector is not grounded by service wire. See Fig. 1. 2) Check malfunction indicator lamp while ignition switch is ON (but without starting engine). See Fig. 2. Does malfunction indicator lamp flash?	Go to Step 3.	• If malfunction indicator lamp remains ON, go to Step 2. • If malfunction indicator lamp remains OFF, go to "Malfunction Indicator Lamp (MIL) Check" in Section 6 for except sports model or in Section 6-1 for sports model.
2	1) Using service wire (2), ground diagnostic switch terminal (3) in diagnosis connector (1). See Fig. 3. Does malfunction indicator lamp flash?	Immobilizer control system is in good condition.	Go to "Malfunction Indicator Lamp (MIL) Check" in Section 6 for except sports model or in Section 6-1 for sports model.
3	Does malfunction indicator lamp flash as Fig. 4?	Go to Step 4.	Go to "Malfunction Indicator Lamp (MIL) Check" in Section 6 for except sports model or in Section 6-1 for sports model.
4	1) Check DTC stored in Immobilizer Control Module referring to "Diagnostic" Trouble Code (DTC) Check (Immobilizer Control Module)" in this section. Is there any DTC(s)?	Go to flow table for DTC No.	Go to Step 5.
5	1) Check DTC stored in ECM referring to "Diagnostic Trouble Code (DTC) Check (ECM)" in this section. Is there any DTC(s)?	Go to flow table for DTC No.	Substitute a known-good ECM and recheck. See NOTE below.

NOTE:

After replacing with a known-good ECM, register ECM/Immobilizer Control Module (ECU) code in ECM by performing procedure described in "Procedure after ECM Replacement" in this section.

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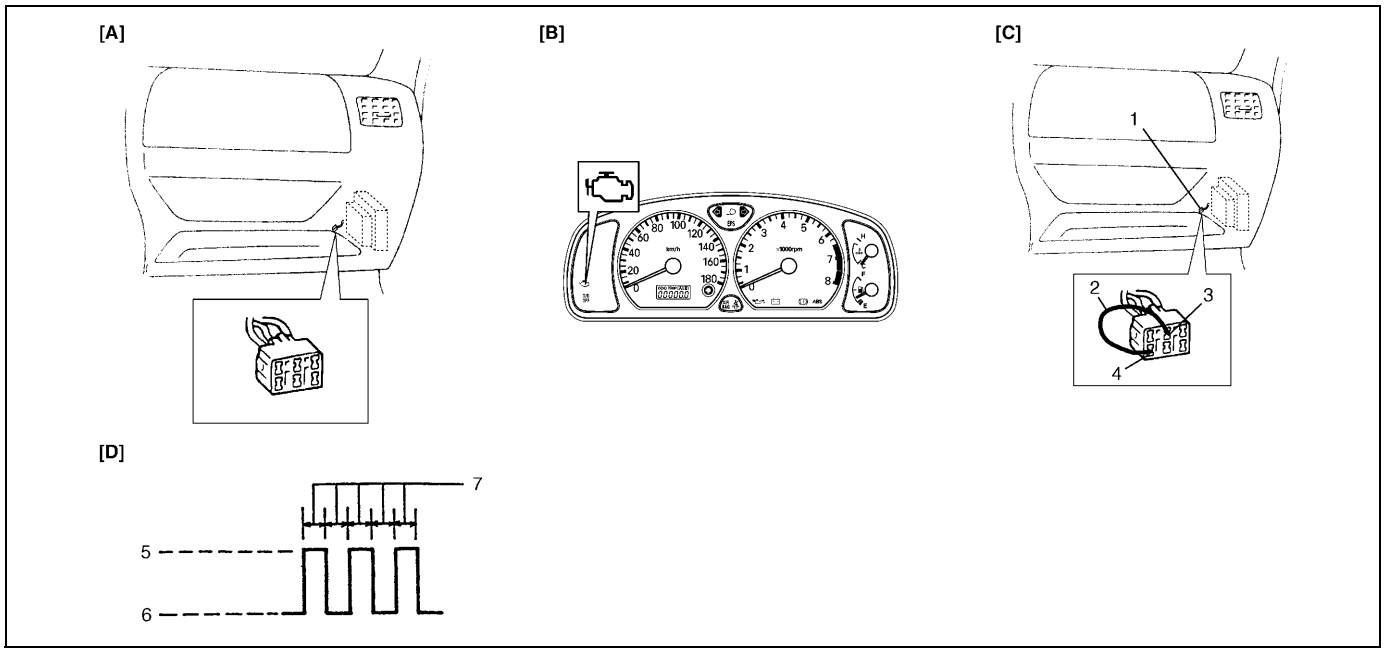

[A]: Fig. 1 for Step 1	[C]: Fig. 3 for Step 2	4. Ground terminal	6. OFF
[B]: Fig. 2 for Step 1	[D]: Fig. 4 for Step 3	5. ON	7. 0.5 sec.

<Vehicle equipped with immobilizer indicator lamp>

Step	Action	Yes	No
1	1) Check immobilizer indicator lamp while ignition switch is ON (but without starting engine). See Fig. 1. Does immobilizer indicator lamp flash?	Go to Step 3.	If immobilizer indicator lamp remains ON, go to Step 2. If immobilizer indicator lamp remains OFF, go to "Table A Immobilizer Indicator Lamp Check" in this section.
2	1) Check DTC stored in ECM referring to "Diagnostic Trouble Code (DTC) Check (ECM)" in this section. Is there any DTC(s)?	Go to "Table B Immobilizer Indicator Lamp Check" in this section.	Immobilizer control system is in good condition.
3	1) Check DTC stored in Immobilizer Control Module referring to "Diagnostic Trouble Code (DTC) Check (Immobilizer Control Module)" in this section. Is there any DTC(s)?	Go to flow table for DTC No.	Go to Step 4.
4	1) Check DTC stored in ECM referring to "Diagnostic Trouble Code (DTC) Check (ECM)" in this section. Is there any DTC(s) for immobilizer control system?	Go to flow table for DTC No.	Substitute a known-good ECM and recheck. See NOTE below.

NOTE:

After replacing with a known-good ECM, register ECM/Immobilizer Control Module code in ECM by performing procedure described in "Procedure after ECM Replacement" section.

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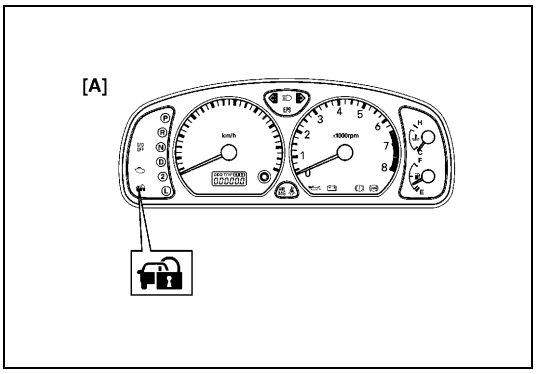
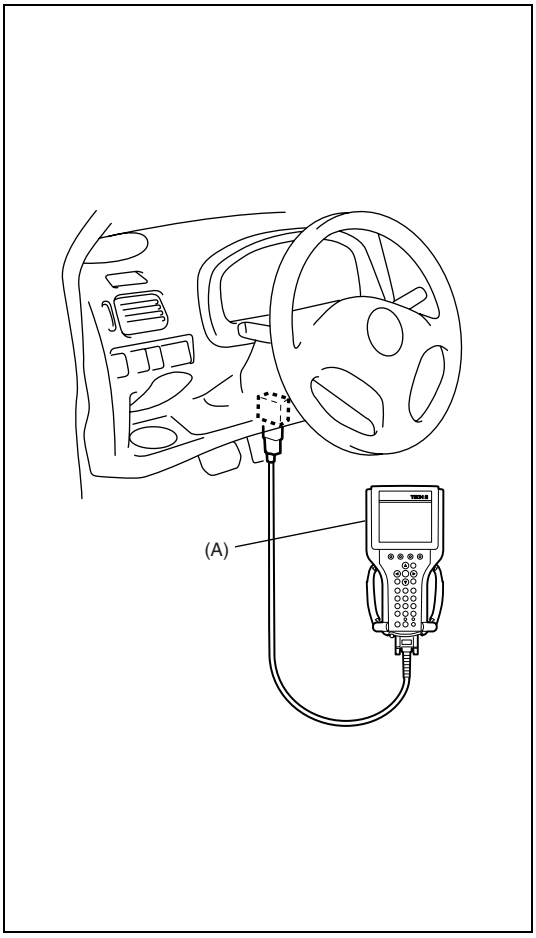


[A]: Fig. 1 for Step 1

Diagnostic Trouble Code (DTC) Check (ECM)

[Using SUZUKI scan tool]

1) Turn ignition switch OFF.
2) After setting cartridge to SUZUKI scan tool, connect it to data link connector (DLC) (1) located on underside of instrument panel at driver's seat side.



Special tool
(A): SUZUKI scan tool

3) Turn ignition switch ON.
4) Read DTC stored in ECM according to instructions displayed on SUZUKI scan tool and print it or write it down. Refer to SUZUKI scan tool operator's manual for further details.
   If communication between SUZUKI scan tool and ECM is not possible, check if SUZUKI scan tool is communicable by connecting it to ECM in another vehicle. If communication is possible in this case, SUZUKI scan tool is in good condition. Then check data link connector and serial data line (circuit) in the vehicle with which communication was not possible.

NOTE:

If ECM detects a trouble in both engine and emission control system and immobilizer control system, SUZUKI scan tool indicates trouble codes of both systems using SUZUKI mode of ECM application.

5) After completing the check, turn ignition switch OFF and disconnect SUZUKI scan tool from data link connector (DLC).

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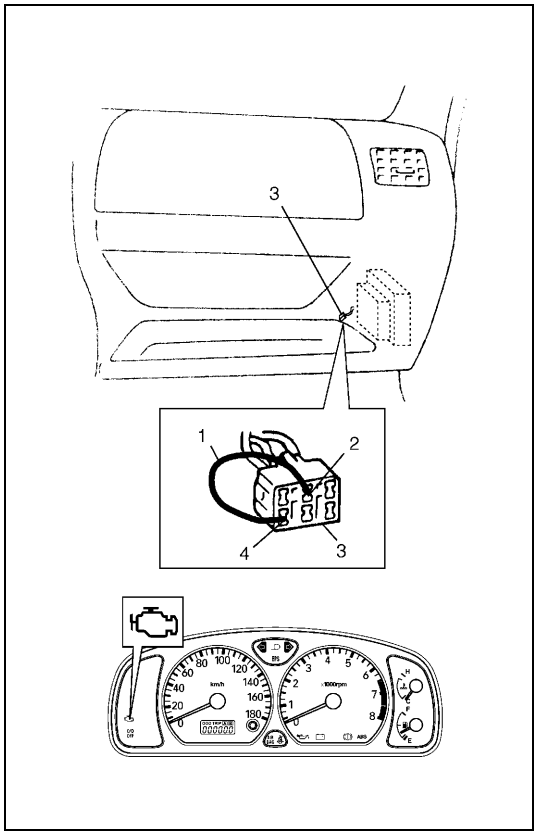


[Not using SUZUKI scan tool] (Except for vehicle equipped with immobilizer indicator lamp)

1) Using service wire (1), ground diagnostic switch terminal (2) in diagnosis connector (3).
2) Read DTC from flashing pattern of malfunction indicator lamp as shown in example below and write it down. For details of DTC, refer to “ECM” in “Diagnostic Trouble Code Table”.
   If lamp remains ON, go to “Malfunction Indicator Lamp Check” in Section 6 for M13 engine model or Section 6-1 for M15 engine model.

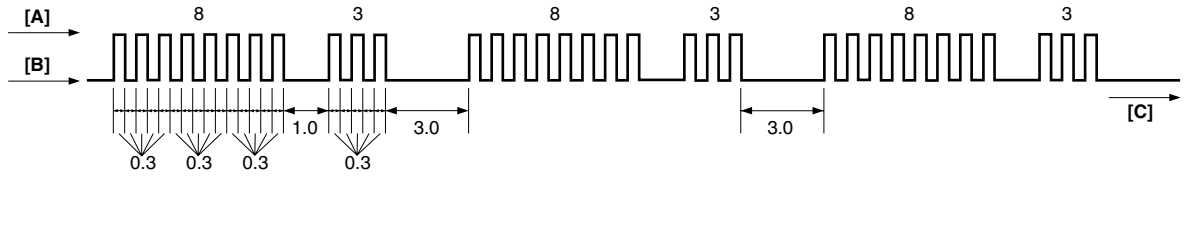
NOTE:

If abnormality or malfunction lies in two or more areas, malfunction indicator lamp indicates applicable codes three times each.
And flashing of these codes is repeated as long as diagnosis terminal is grounded and ignition switch is held at ON position.

4. Ground terminal

3) After completing the check, turn ignition switch OFF and disconnect service wire from monitor coupler.

Example of Malfunction Indicator Lamp Flashing Pattern (Code No.83)



[A]: ON
[B]: OFF
[C]: Time (sec.)

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Diagnostic Trouble Code Table

Immobilizer Control Module

DTC (indicated on SUZUKI Scan Tool)	Diagnostic Area	Diagnosis
NO DTC	Normal (No code)	This code appears when none of the other codes are identified.
11	Transponder code	Diagnose trouble according to “Diagnostic Flow Table” corresponding to each code No.
31		
32		
12	Immobilizer Control Module	
13	Coil antenna or ignition key with built-in transponder	
21	ECM/Immobilizer Control Module (ECU) code	
22	Ignition switch circuit	
23	Serial data link circuit	

ECM

To learn how to read diagnostic trouble code (DTC) from flashing pattern of malfunction indicator lamp (MIL), refer to “Diagnostic Trouble Code (DTC) Check” in Section 6 for M13 engine model or Section 6-1 for M15 engine model.

DTC (indicated on SUZUKI Scan Tool)	DTC (indicated by MIL)	Malfunction Indicator Lamp (MIL) Flashing Pattern	Diagnostic Area	Diagnosis
NO DTC	12		Normal	This code appears when it is confirmed that none of other trouble codes is set for immobilizer control system or engine and emission control system.
P1623	81		ECM/Immobilizer Control Module (ECU) code	Diagnose trouble according to “Diagnostic Flow Table” corresponding to each code No.
P1620	84			
P1622	82		ECM	
P1621	83		Serial data link wire	

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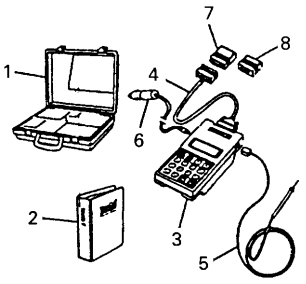
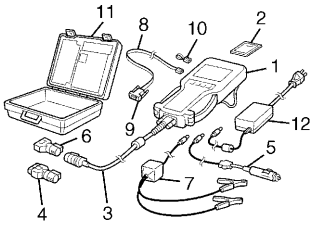
Special Tool

	
09931-76011 Tech-1A kit (SUZUKI scan tool) (See NOTE “A”.)	Tech-2 kit (SUZUKI scan tool) (See NOTE “B”.)

NOTE:

- **“A”: This kit includes the following items, and this kit is applicable only for except sports model.**
  1. Storage case, 2. Operator's manual, 3. Tech-1A, 4. DLC cable, 5. Test lead/probe, 6. Power source cable, 7. DLC cable adapter, 8. Self-test adapter
- **“B”: This kit includes the following items, and this kit is applicable for both except sports model and sports model.**
  1. Tech 2. PCMCIA card, 3. DLC cable, 4. SAE 16-19 adapter, 5. Cigarette cable, 6. DLC loopback adapter, 7. Battery power cable, 8. RS232 cable, 9. RS232 adapter, 10. RS232 loopback connector, 11. Storage case, 12. Power supply

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SECTION 9

BODY SERVICE

WARNING:

For vehicles equipped with a Supplemental Restraint (Air Bag) System:

- **Service on and around the air bag system components or wiring must be performed only by an authorized SUZUKI dealer. Refer to "Air Bag System Components and Wiring Location View" under "General Description" in air bag system section in order to confirm whether you are performing service on or near the air bag system components or wiring. Please observe all WARNINGS and "Service Precautions" under "On-Vehicle Service" in air bag system section before performing service on or around the air bag system components or wiring. Failure to follow WARNINGS could result in unintentional activation of the system or could render the system inoperative. Either of these two conditions may result in severe injury.**
- **Technical service work must be started at least 90 seconds after the ignition switch is turned to the "LOCK" position and the negative cable is disconnected from the battery. Otherwise, the system may be activated by reserve energy in the Sensing and Diagnostic Module (SDM).**
- **When body servicing, if shock may be applied to air bag system component parts, remove those parts beforehand. (Refer to Section 10B.)**

NOTE:

- **For the items with asterisk (*) in the "CONTENTS" below, refer to the same section of the Service Manual mentioned in "FOREWORD" of this manual.**
- **Fasteners are important attaching parts in that they could affect the performance of vital components and systems, and / or could result in major repair expense. They must be replaced with one of the same part number of with an equivalent part if replacement becomes necessary.**
  Do not use a replacement part of lesser quality or substitute a design. Torque values must be used as specified during reassembly to assure proper retention of these parts.

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Anti-corrosion Treatment ..... *
Sealant Application Areas 9-23
Under Coating Application Areas 9-30
Anti-corrosion Compound Application Area 9-32
Required Service Material **9-33**

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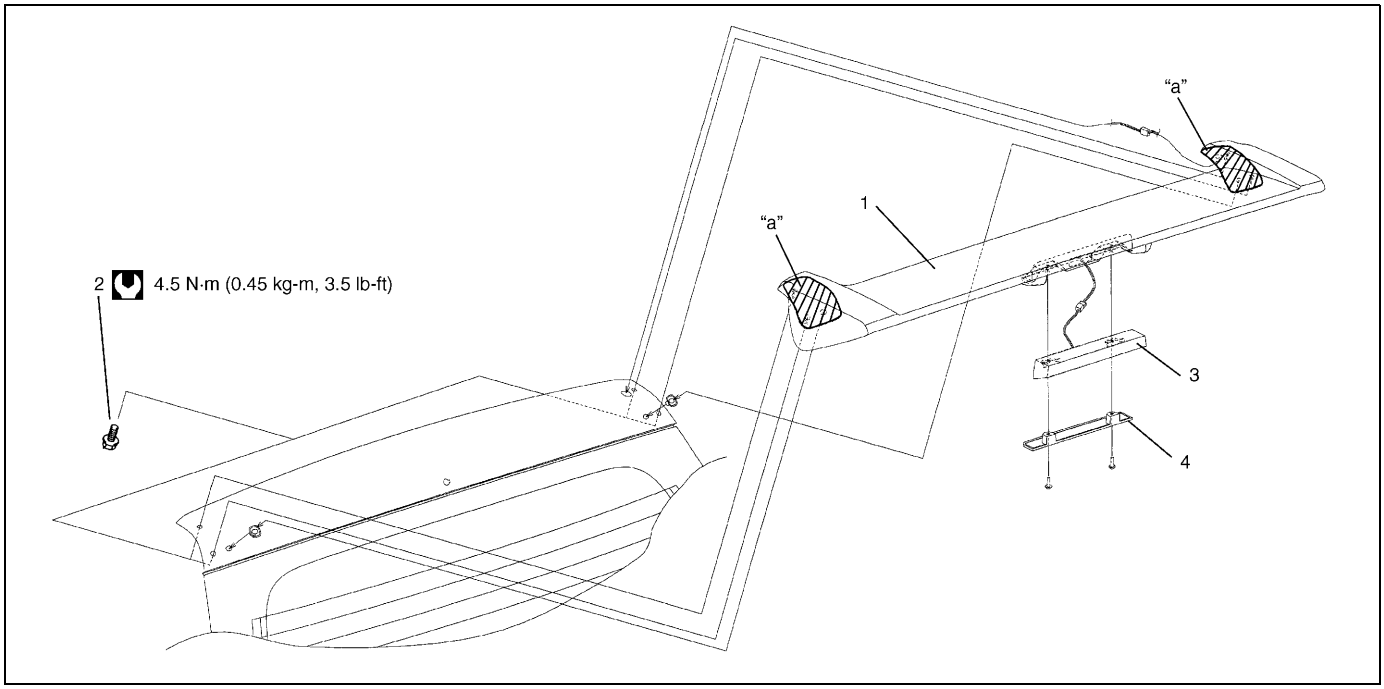
Body Structure

Rearend Door Spoiler Removal and Installation (Sport Model)

When removing or installing rearend door spoiler, refer to the figure.



"a": Adhesive tape (3M #4213)	2. Rearend door spoiler mounting bolt	4. High mount stop lamp cover
1. Rearend door spoiler	3. High mount stop lamp assembly	Tightening torque

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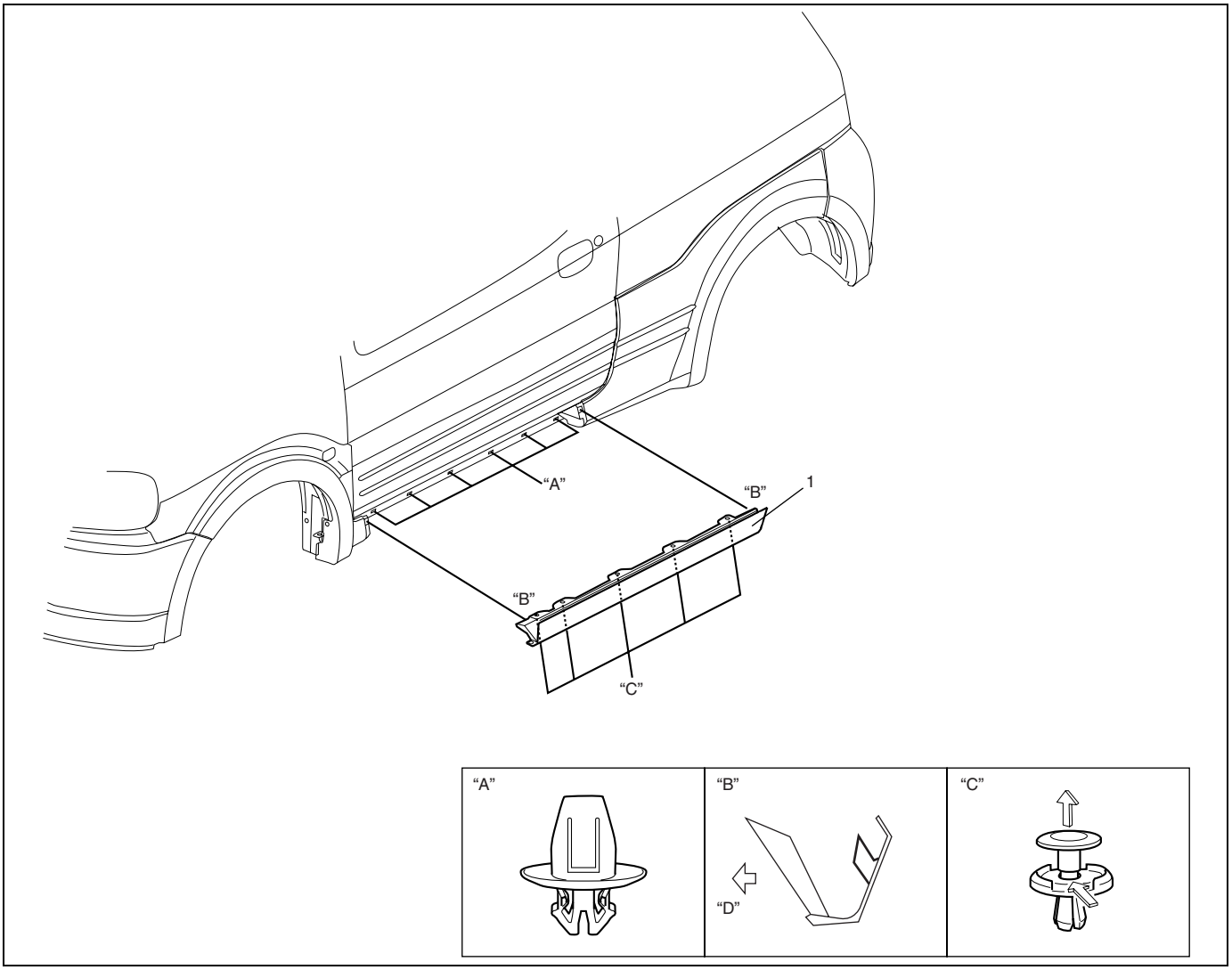
Sill Panel Extension (Sport Model)



"D": Center of vehicle

Removal

1) Remove clips "C".
2) Protect paintwork with shop rag and using screwdriver, carefully prise sill panel extension (1) from front and rear fender extensions "B".
3) Protect paintwork with shop rag and using screwdriver, carefully prise sill panel extension from vehicle and remove sill panel extension (1).

Installation

Reverse removal procedure for installation.

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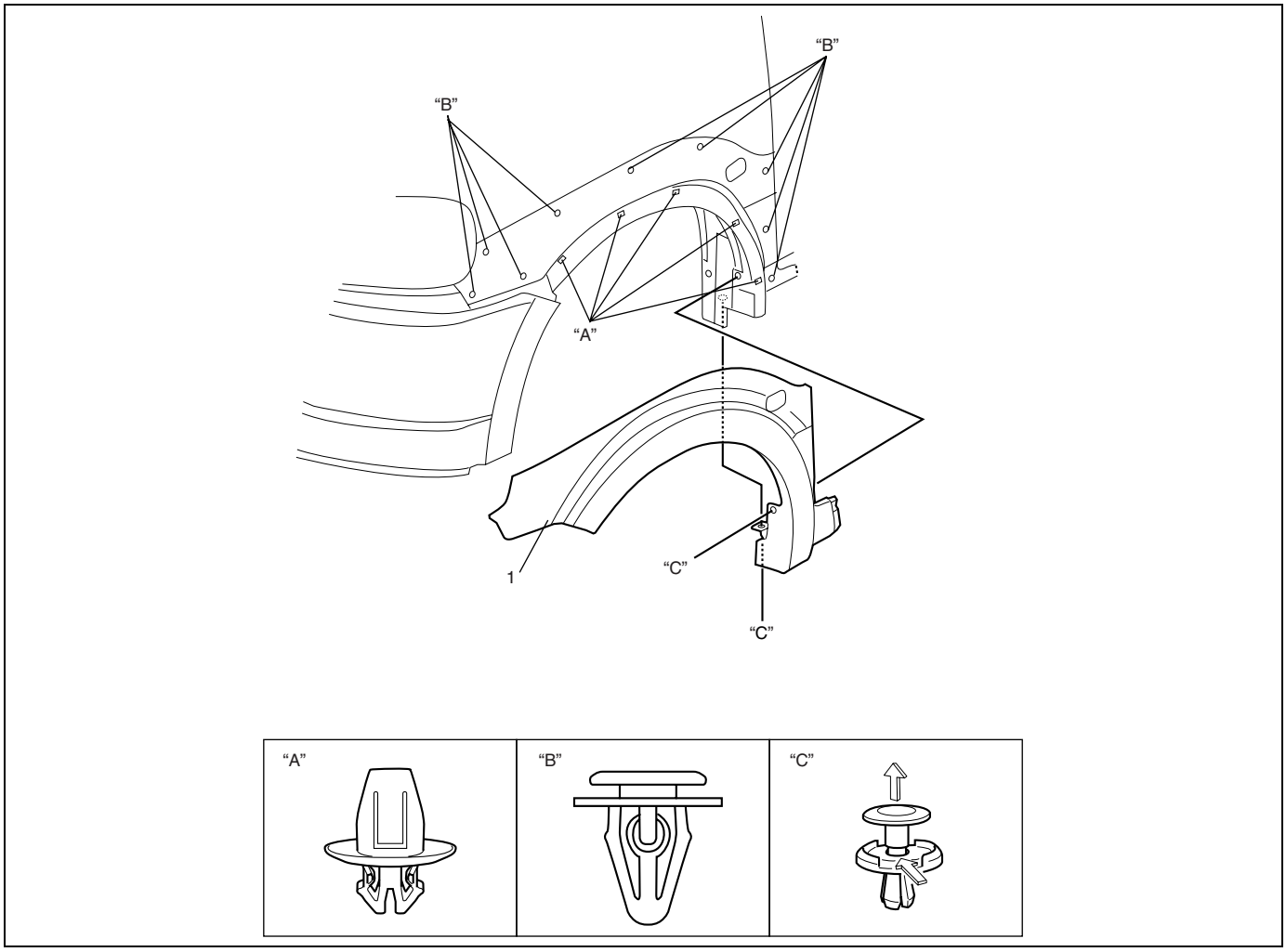
Front Fender Extension (Sport Model)



Removal

1) Detach front section of sill panel extension from the front fender extension (1).
2) Remove clips "C".
3) Protect paintwork with shop rag and using screwdriver, carefully prise front fender extension (1) from front fender.

Installation

Reverse removal procedure for installation.

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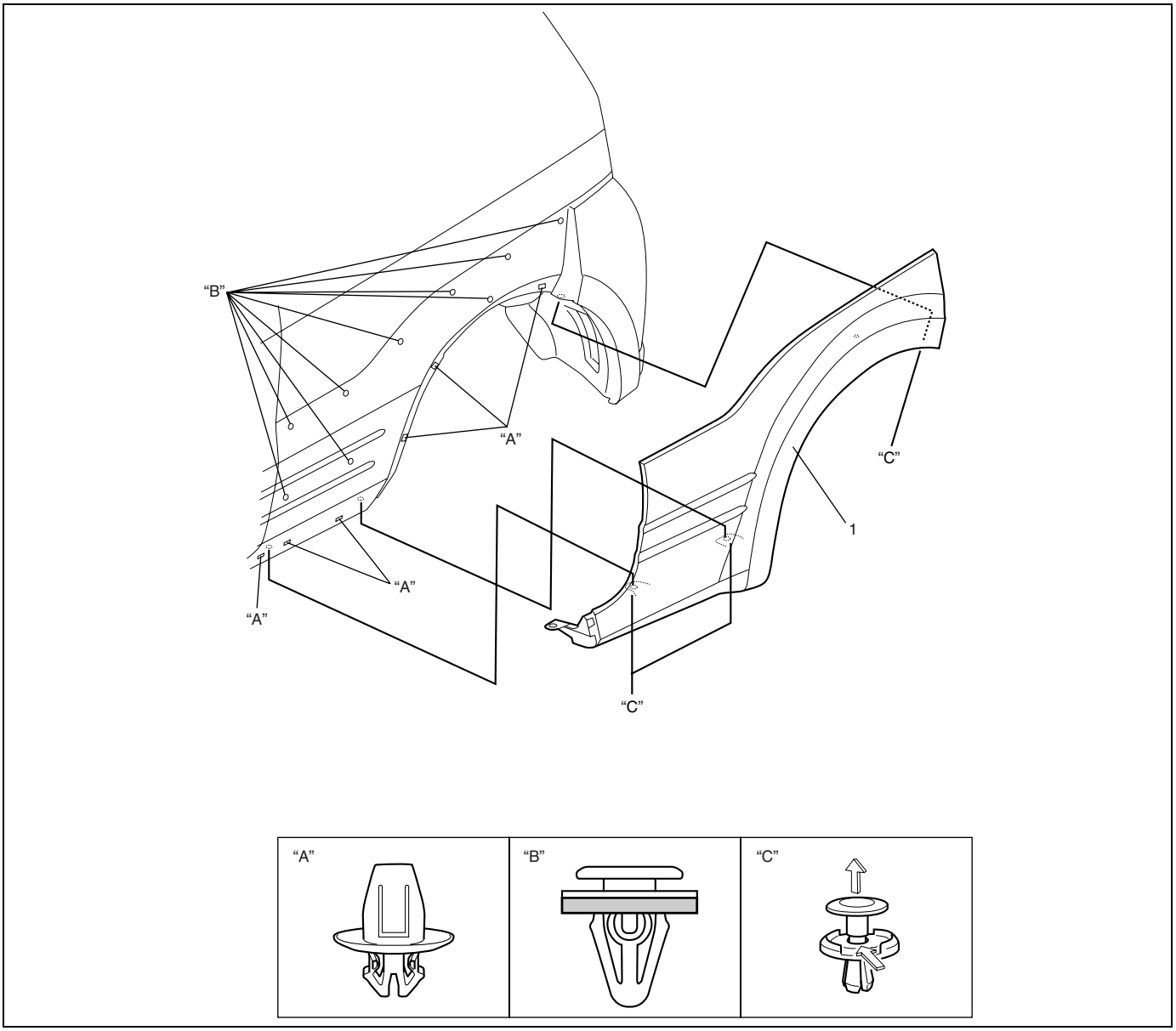
Rear Fender Extension (Sport Model)



Removal

1) Detach front section of sill panel extension from front fender extension (1).
2) Remove clips "C".
3) Protect paintwork with shop rag and using screwdriver, carefully prise front fender extension (1) from front fender.

Installation

Reverse removal procedure for installation.

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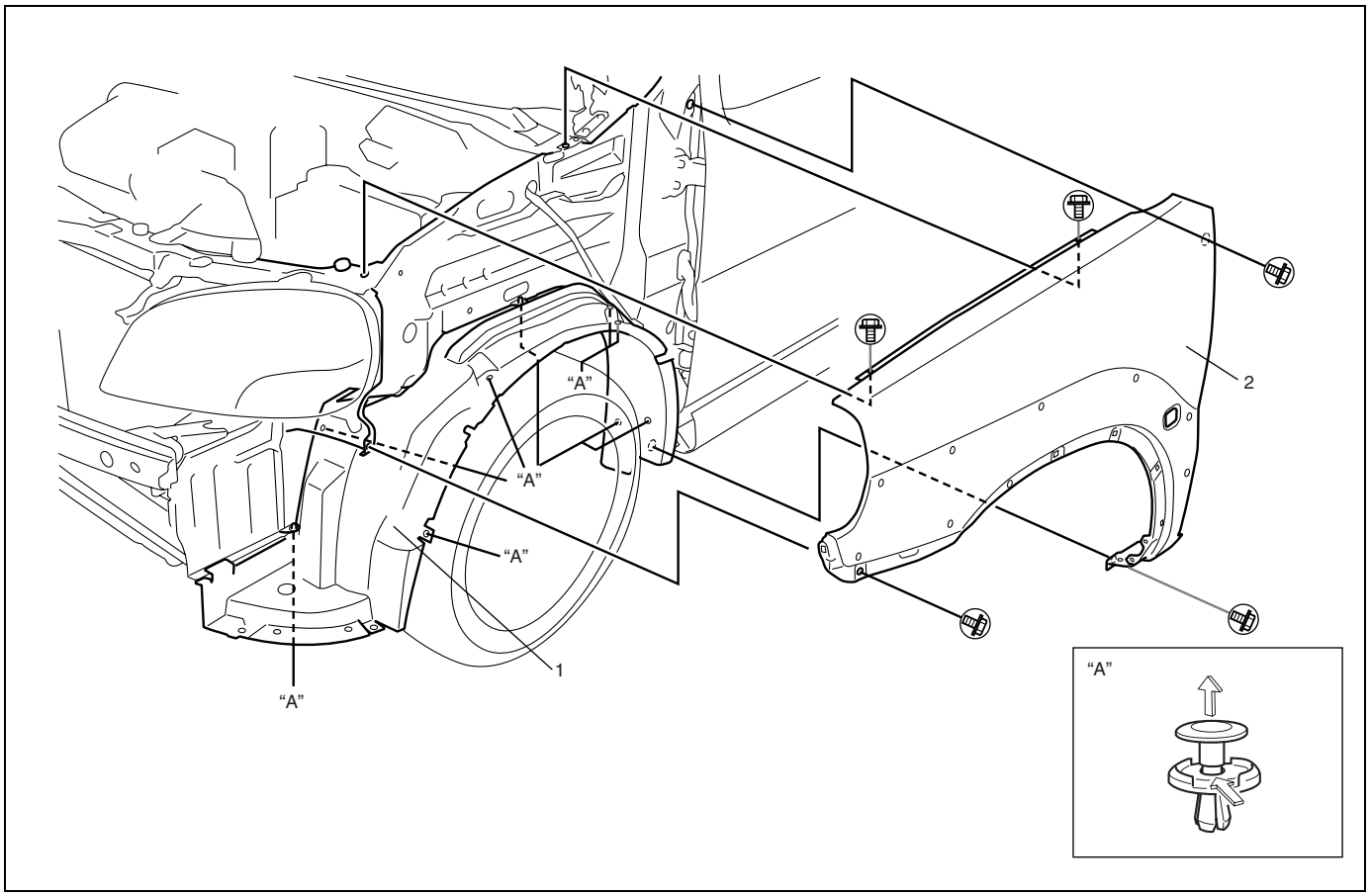
Front Fender

NOTE:
For 1.3 L engine model, refer to the same section of the Service Manual mentioned in "FOREWORD" of this manual.

Sport model



1. Front fender lining	2. Front fender

Removal

1) Disconnect side turn signal lamp connector.
2) Remove front fender lining (1).
3) Remove front fender extension referring to "Front Fender Extension (Sport Model)" in this section.
4) Remove front bumper referring to "Front Bumper (Sport Model)" in this section.
5) Remove front fender (2).

Installation

Reverse removal procedure to install front fender noting the following instructions.

- If paint on fender bolt is peeled off, be sure to apply paint again.
- Adjust panel clearance referring to "Panel Clearance" in this section.

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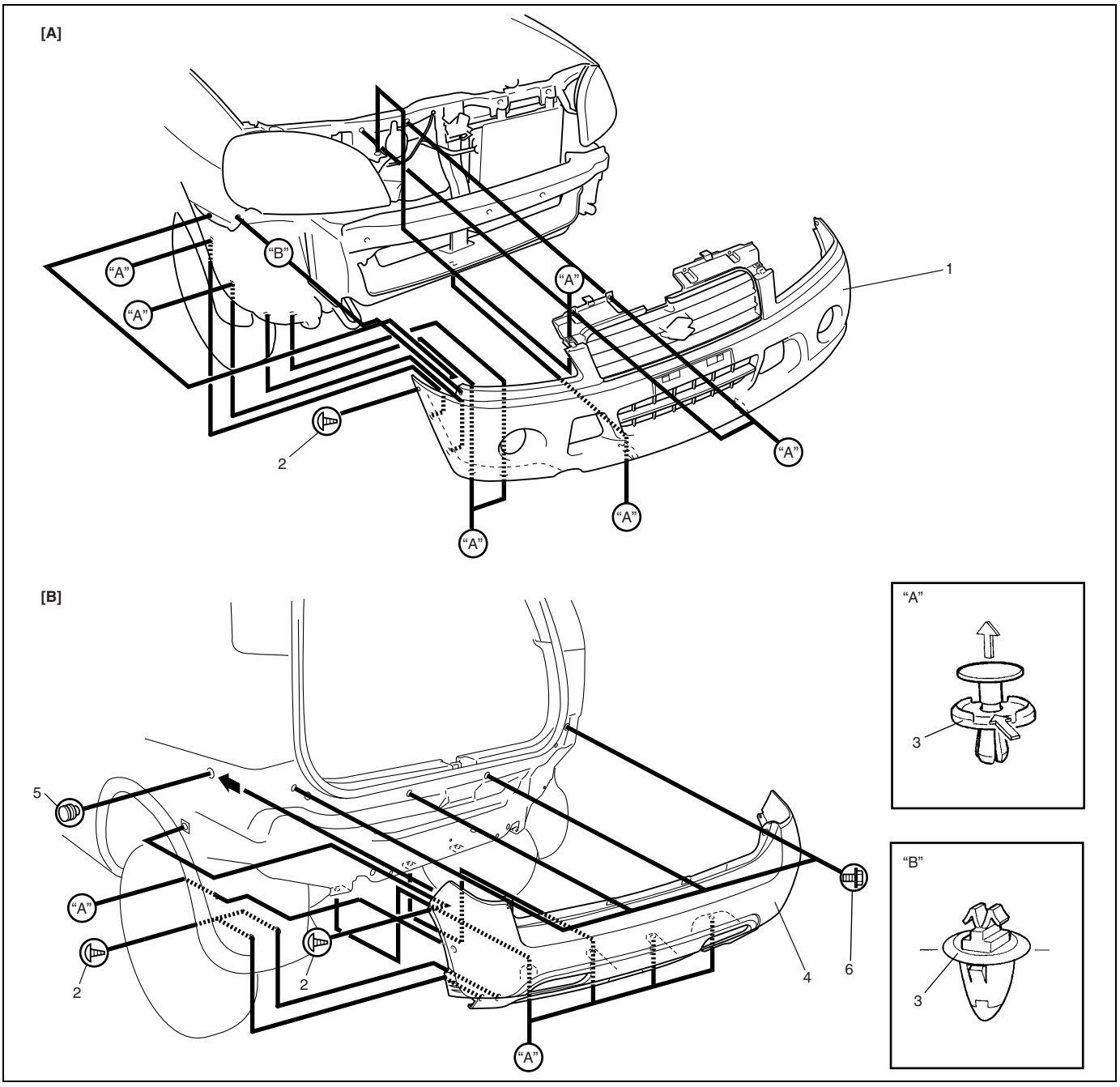
Front Bumper and Rear Bumper

Front and rear bumper (except sport model)



[A] : Front bumper	1. Front bumper	4. Rear bumper
[B] : Rear bumper	2. Screws	5. Damper
	3. Clip	6. Bolt

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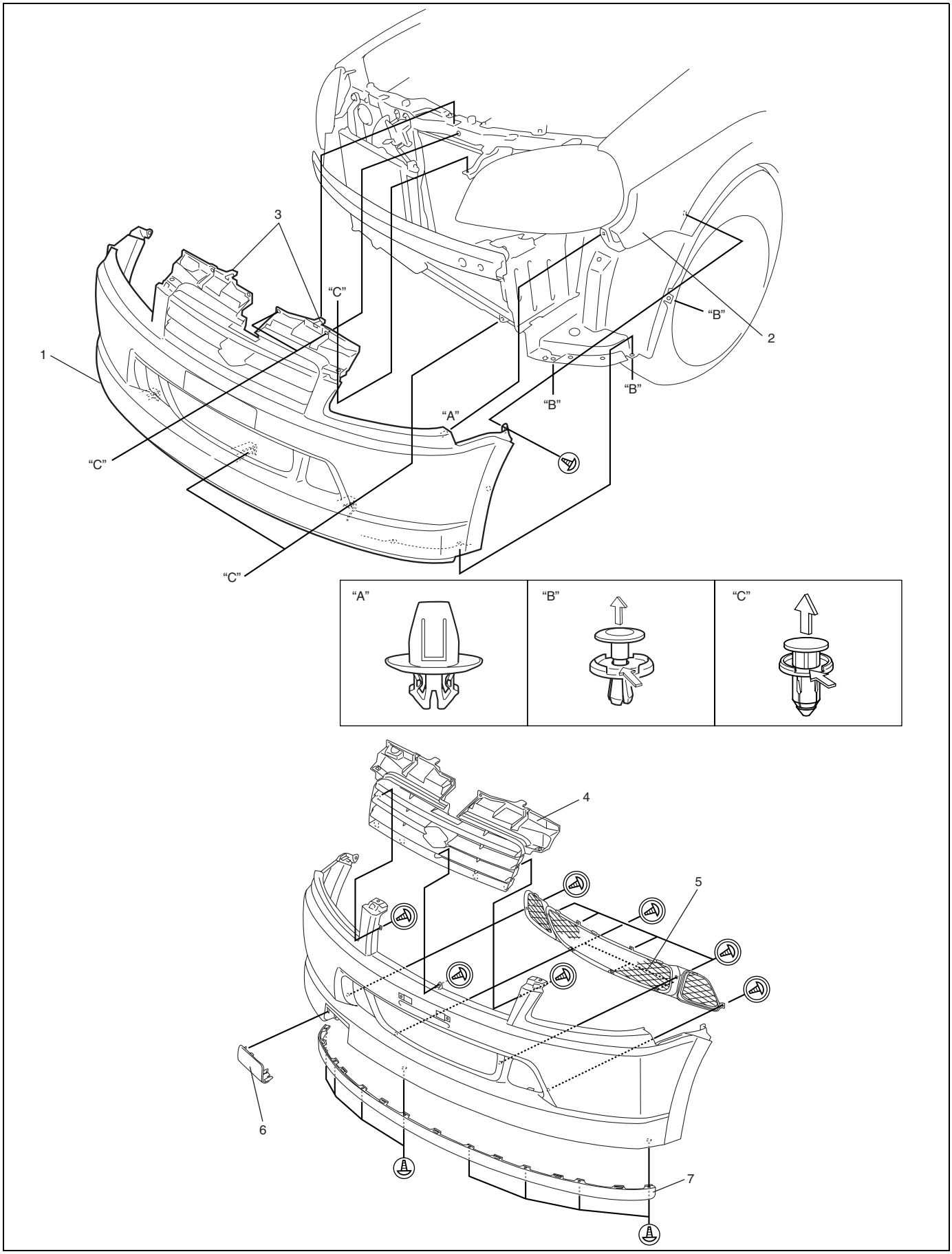
Front bumper (sport model)



4. Radiator grille	5. Lower grille	6. Towing hook cover	7. Air dam skirt

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Removal

1) Partially remove front fender extension (2) referring to “Front Fender Extension (Sport Model)” and remove front fender liner where it attaches front bumper (1).
2) Remove screws and clips “B” and “C”.
3) Prise two retainers (3) securing bumper to radiator support panel and remove bumper (1).

Installation

Reverse removal procedure for installation.

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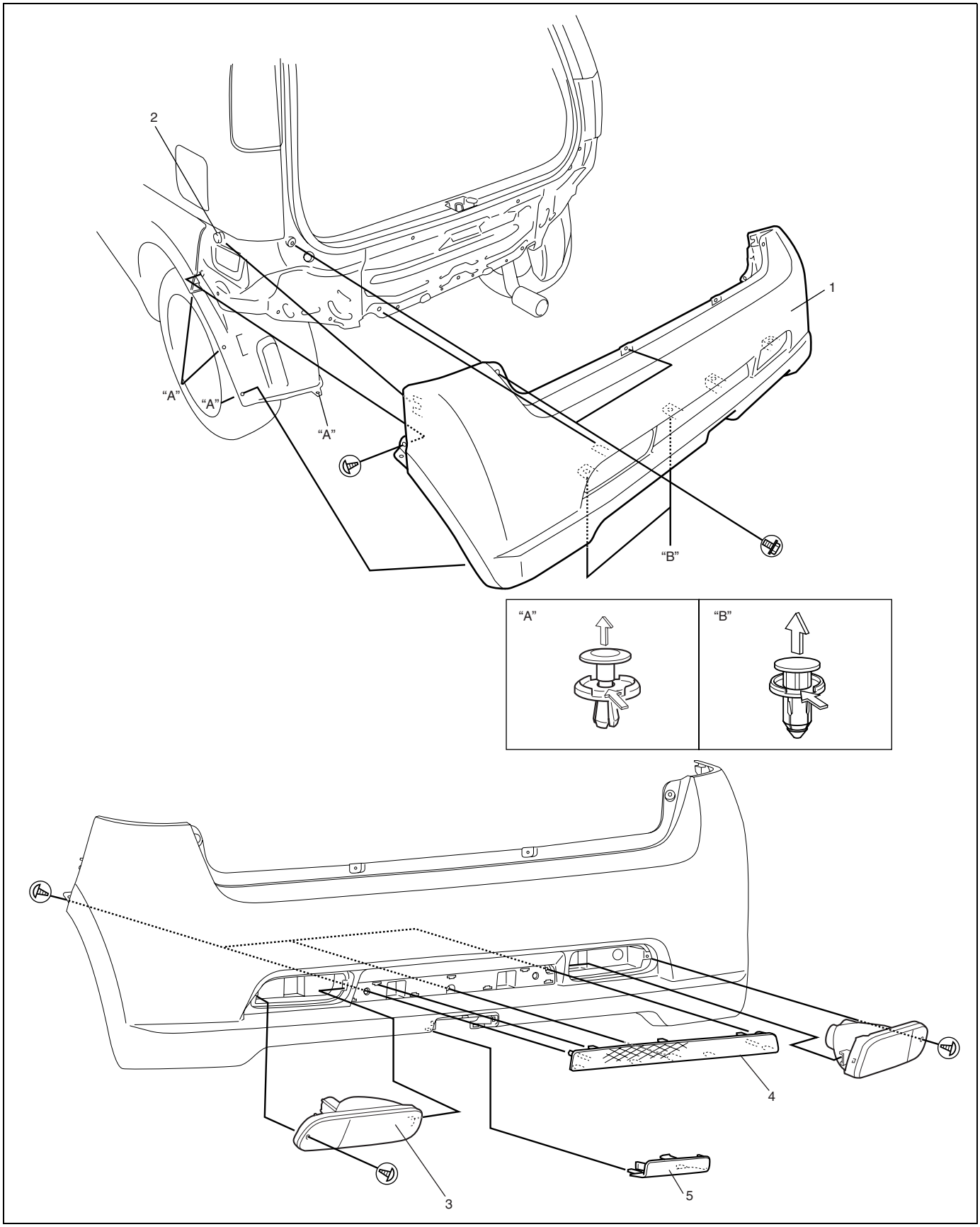
Rear bumper (sport model)



3. Rear fog lamp	4. Rear bumper net	5. Towing hook cover

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Removal

1) Partially remove the rear fender extension, refer to “Rear Fender Extension (Sport Model)”, and the rear fender liner where it attaches rear bumper (1).
2) Remove screws.
3) Remove the clips “A” and “B” attaching the bumper to the vehicle.
4) Remove the bumper from the vehicle, disengaging it from the damper (2) each side.
5) Disconnect the rear fog lamp wiring connector.

Installation

Reverse removal procedure for installation.

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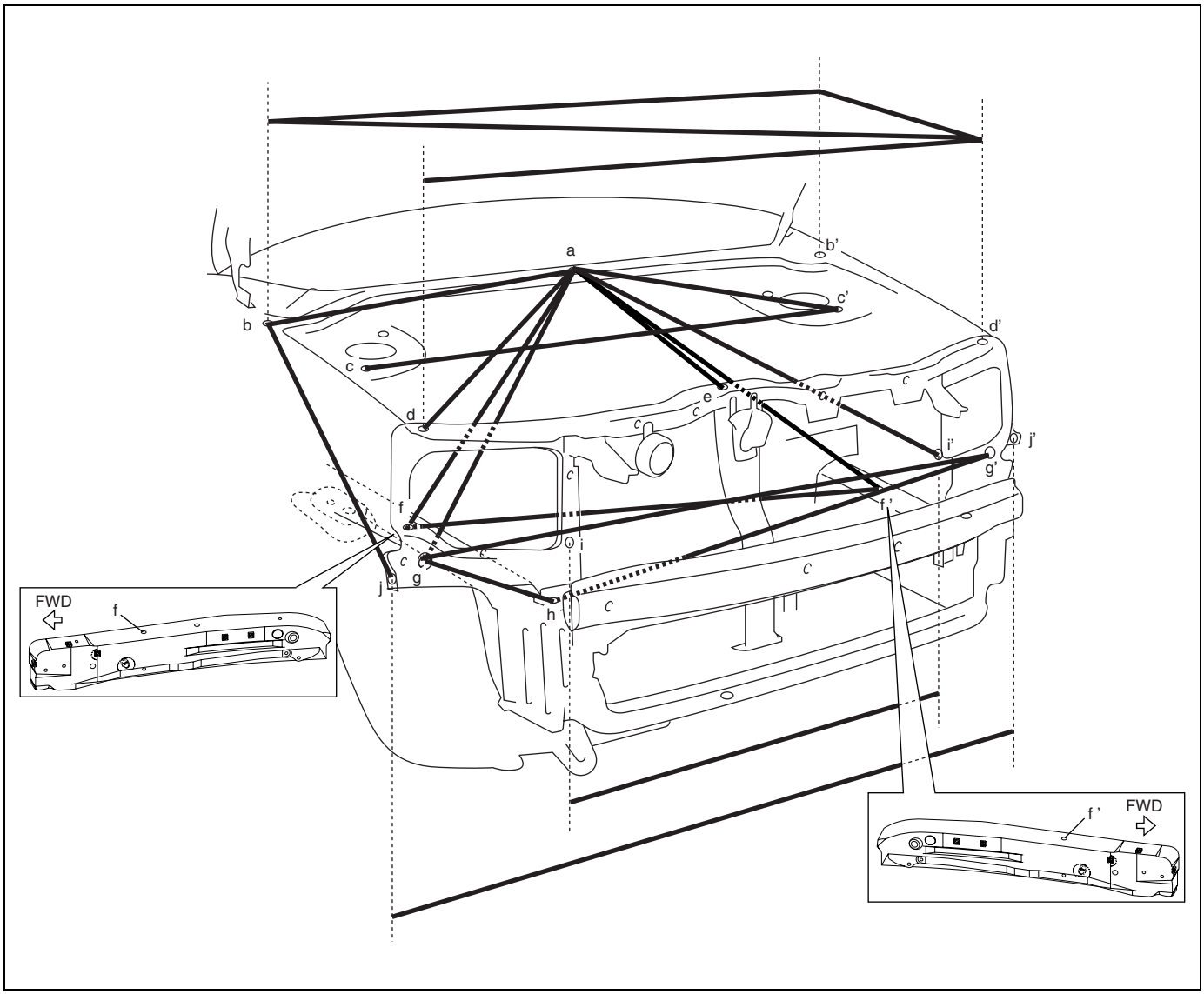
Body Dimensions

Engine room



a. Garnish installation center hole (ϕ5)	e. Hood cushion installation hole	i (i'). Head light installation hole
b (b'). Front fender installation hole	f (f'). Engine mounting installation front hole	j (j'). Front fender installation hole
c (c'). Strut installation front hole	g (g'). Jig hole (ϕ15 mm)	
d (d'). Front fender installation hole	h. Bumper member upper side installation hole	

Hole to hole distance

a-b: 673 mm (26.50 in.)	**a-g: 889 mm (35.00 in.)**	**d-d': 1320 mm (51.97 in.)**
a-c': 584 mm (22.99 in.)	**a-i': 758 mm (29.84 in.)**	**f-f': 950 mm (37.40 in.)**
a-d: 793 mm (31.22 in.)	**b-b': 1340 mm (52.76 in.)**	**g-g': 1315 mm (51.77 in.)**
a-e: 584 mm (22.99 in.) (except sport model)	**b-d': 1411 mm (55.55 in.)**	**g-h: 231 mm (9.09 in.)**
a-e: 599 mm (23.58 in.) (sport model)	**b-j: 639 mm (25.16 in.)**	**g'-h: 1139 mm (44.84 in.)**
a-f: 774 mm (30.47 in.)	**b'-d': 470 mm (18.50 in.)**	**i-i': 866 mm (34.09 in.)**
a-f': 777 mm (30.59 in.)	**c-c': 1098 mm (43.23 in.)**	**j-j': 1496 mm (58.90 in.)**

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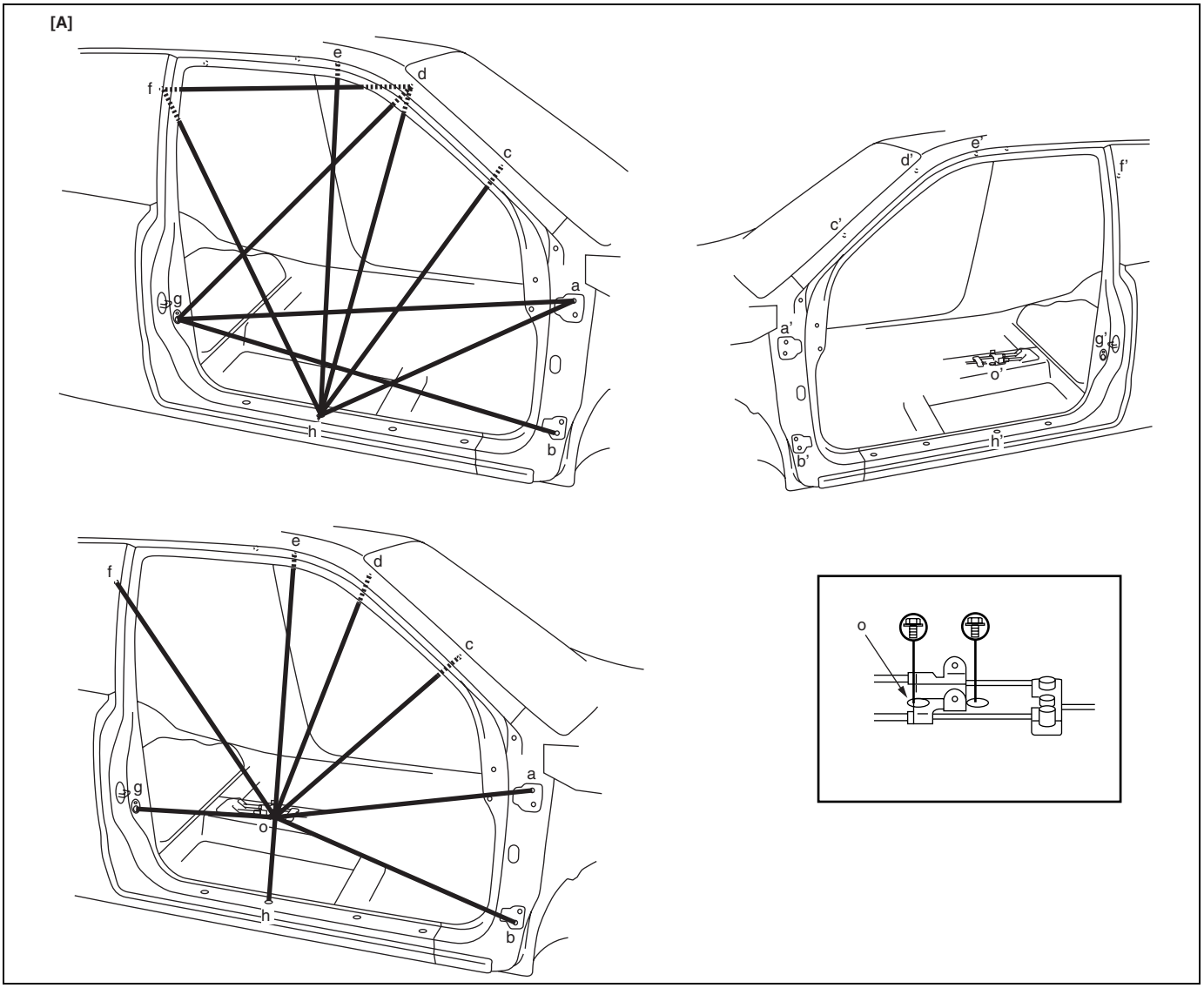
Side body



[A] : 3 door model	f (f'). Front shoulder adjuster installation upper hole
a (a'). Door upper hinge installation hole	g (g'). Door switch installation hole
b (b'). Door lower hinge installation hole	h (h'). Side sill scuff installation hole
c (c'). Front pillar inner trim installation lower hole	o. Parking brake cable bracket installation rear hole
d (d'). Front pillar inner trim installation upper hole	
e (e'). Assistant grip installation front hole	

Hole to hole distance

a-g: 1168 mm (45.98 in.)	**d-h: 1005 mm (39.57 in.)**	**d-o: 1252 mm (49.29 in.)**
a-h: 852 mm (33.54 in.)	**e-h: 1075 mm (43.23 in.)**	**e-o: 1244 mm (48.98 in.)**
b-g: 1188 mm (46.77 in.)	**f-h: 1091 mm (42.95 in.)**	**f-o: 1173 mm (46.18 in.)**
c-h: 918 mm (36.14 in.)	**a-o: 1317 mm (51.85 in.)**	**g-o: 799 mm (31.46 in.)**
d-f: 720 mm (28.35 in.)	**b-o: 1222 mm (48.11 in.)**	**h-o: 757 mm (29.80 in.)**
d-g: 933 mm (36.73 in.)	**c-o: 1283 mm (50.51 in.)**	
a-a': 1435 mm (56.50 in.)	**d-d': 1156 mm (45.51 in.)**	**g-g': 1384 mm (54.49 in.)**
b-b': 1452 mm (57.17 in.)	**e-e': 1070 mm (42.13 in.)**	**h-h': 1405 mm (55.31 in.)**
c-c': 1291 mm (50.83 in.)	**f-f': 1203 mm (47.36 in.)**	

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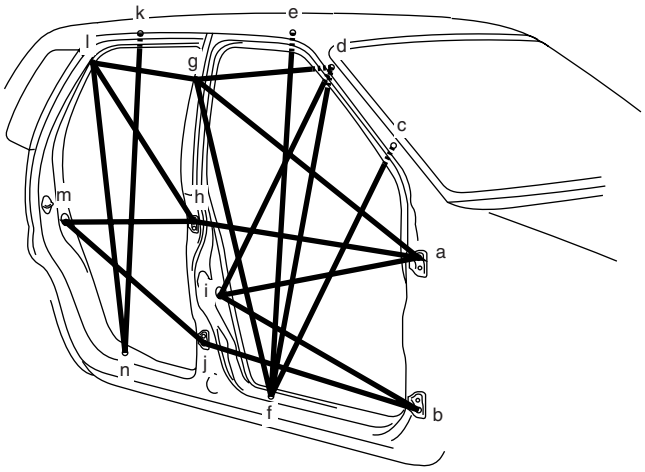
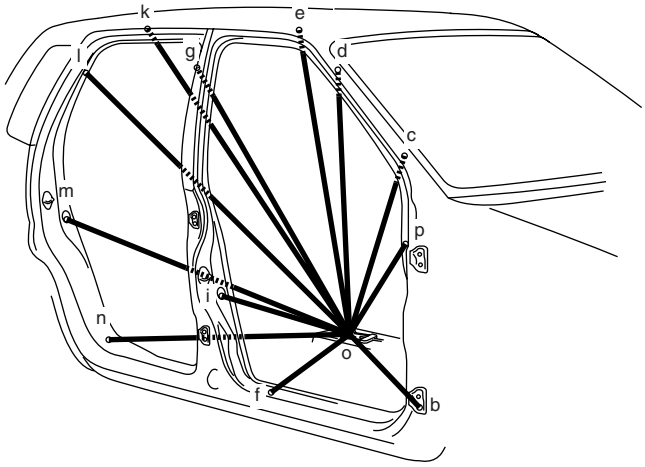
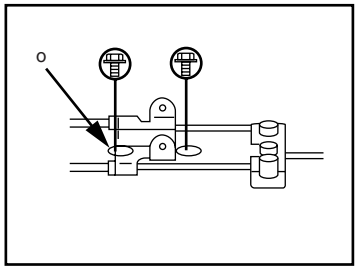
[B]







[B] : 5 door model	f. Side sill scuff installation rear hole	l. Rear door rear notch
a. Front door upper hinge installation hole	g. Front shoulder adjuster installation upper hole	m. Rear door switch installation hole
b. Front door lower hinge installation hole	h. Rear door upper hinge installation hole	n. Side soil scuff installation rear hole
c. Front pillar inner trim installation lower hole	i. Front door switch installation hole	o. Parking brake cable bracket installation rear hole
d. Front pillar inner trim installation upper hole	j. Rear door lower hinge installation hole	p. Steering support member installation hole
e. Assistant grip installation front hole	k. Assistant grip installation hole	

Hole to hole distance

a-g : 1166 mm (45.90 in.)	**d-i : 820 mm (32.28 in.)**	**i-o : 740 mm (29.13 in.)**
a-h : 942 mm (37.09 in.)	**d-o : 1252 mm (49.29 in.)**	**j-m : 895 mm (35.24 in.)**
a-i : 901 mm (35.47 in.)	**e- f : 1077 mm (42.40 in.)**	**k-n : 1100 mm (43.30 in.)**
b-i : 891 mm (35.08 in.)	**e-o : 1243 mm (48.94 in.)**	**k-o : 1321 mm (52.01 in.)**
b-j : 902 mm (35.51 in.)	**f-g: 1048 mm (41.26 in.)**	**l-n : 981 mm (38.62 in.)**
b-o : 1222 mm (48.11 in.)	**f-o 785 mm (30.91 in.)**	**l-o : 1323 mm (52.09 in.)**
c-f : 884 mm (34.80 in.)	**g-l : 621 mm (24.45 in.)**	**m-o : 1111 mm (43.74 in.)**
c-o: 1282 mm (50.47 in.)	**g-o : 1146 mm (45.12 in.)**	**n-o : 771 mm (30.35 in.)**
d-f : 993 mm (39.09 in.)	**h-l : 846 mm (33.31 in.)**	**o-p : 1267 mm (49.88 in.)**
d-g : 580 mm (22.83 in.)	**h-m : 813 mm (32.01 in.)**	

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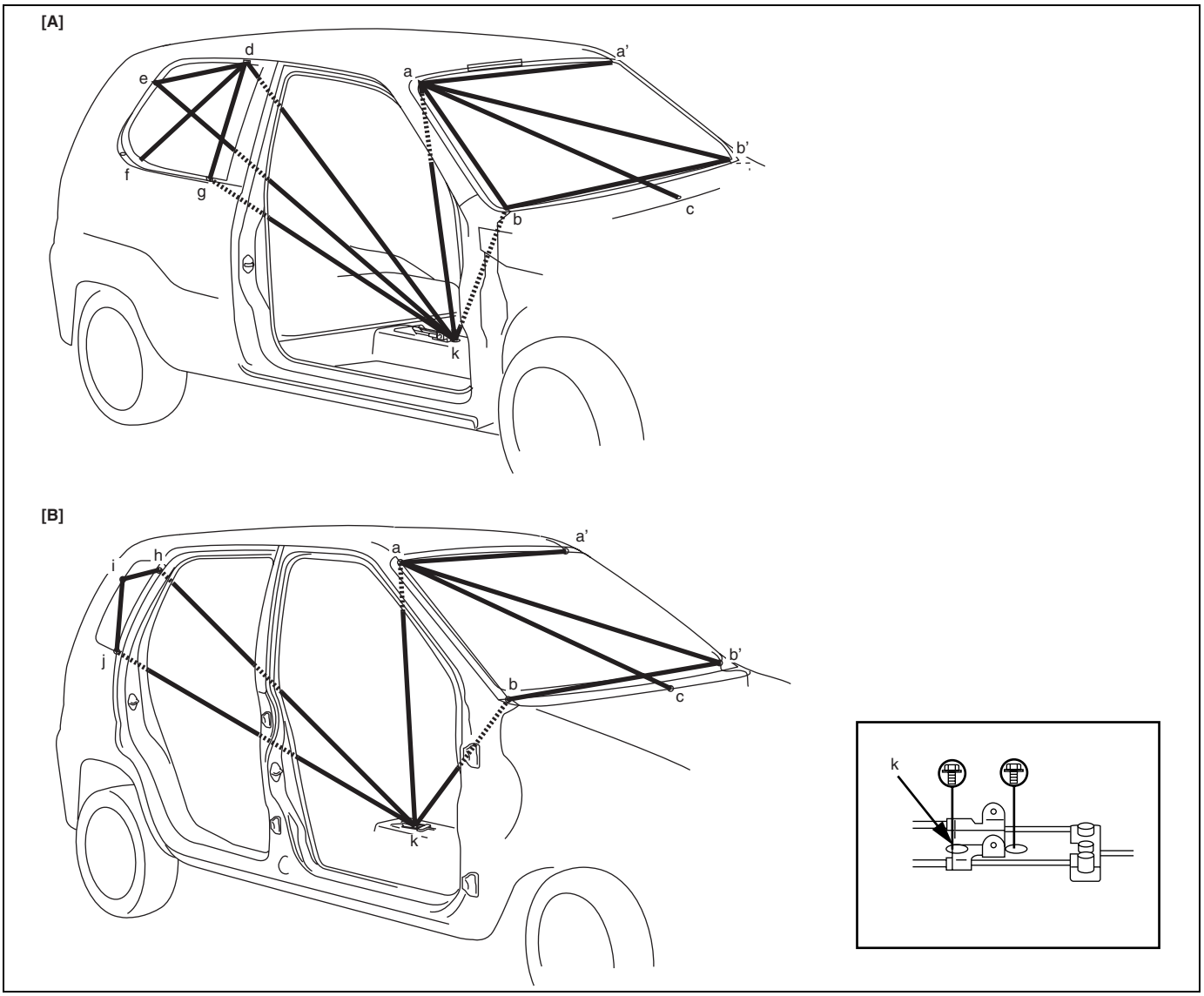

[A] : 3 door model	f. Quarter window lower side rear mounting hole (5.1 x 8.6 mm)
[B] : 5 door model	g. Quarter window lower side front mounting hole (5.1 x 8.6 mm)
a (a'). Front end of front windshield upper installation section	h. Quarter window upper notch
b (b'). Front end of front windshield lower installation section	i. Quarter window rear notch
c. Garnish installation center hole (ϕ5 mm)	j. Quarter window lower mounting hole (5.1 x 8.6 mm)
d. Quarter window upper side front notch	k. Parking brake cable bracket installation rear hole
e. Quarter window rear notch	

Hole to hole distance

a-a' : 1047 mm (41.22 in.)	**b-k : 1419 mm (55.87 in.)**	**g-k : 1091 mm (42.95 in.)**
a-b : 710 mm (27.95 in.)	**d-e : 577 mm (22.72 in.)**	**h-i : 237 mm (9.33 in.)**
a-b' : 1368 mm (53.86 in.)	**d-f : 623 mm (24.53 in.)**	**h-k : 1430 mm (56.30 in.)**
a-c : 1032 mm (40.63 in.)	**d-g : 363 mm (14.29 in.)**	**i-j : 242 mm (9.53 in.)**
a-k : 1281 mm (50.43 in.)	**d-k : 1270 mm (50.00 in.)**	**j-k : 1413 mm (55.63 in.)**
b-b' : 1305 mm (51.38 in.)	**e-k : 1474 mm (58.03 in.)**	

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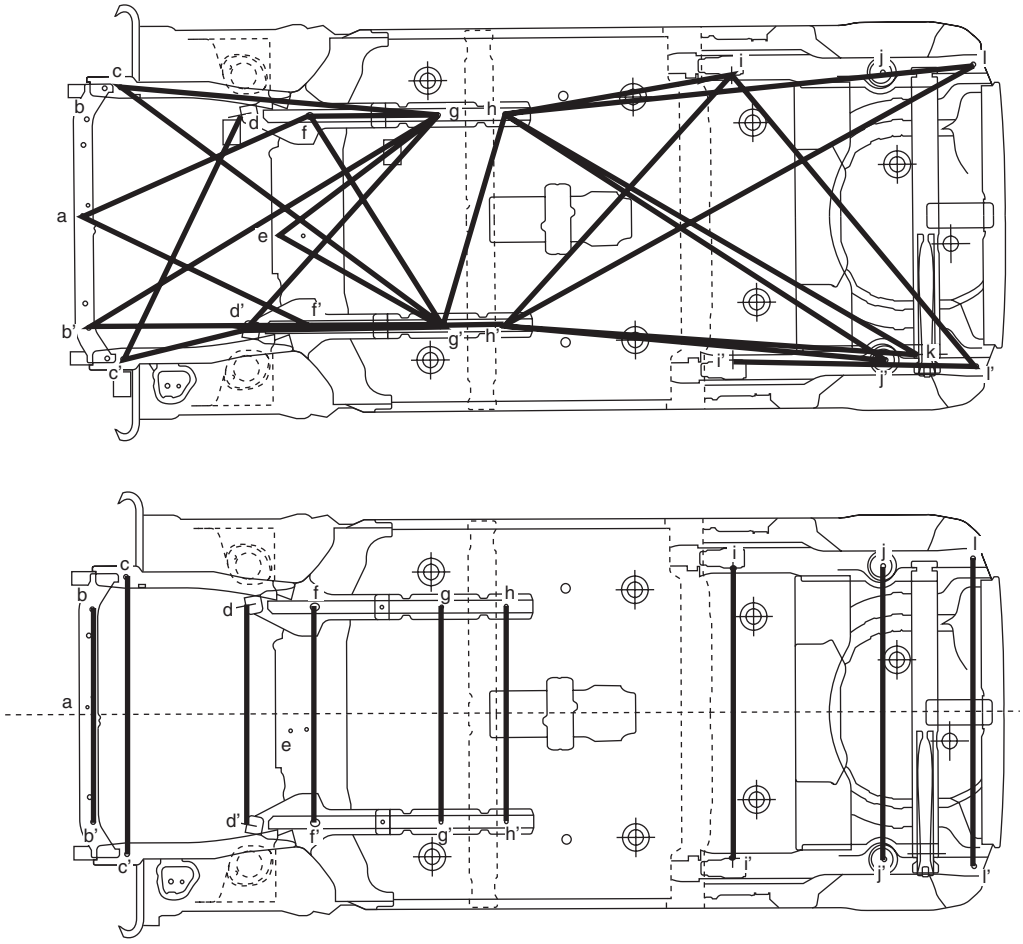
Under body



a.	Jack bracket installation hole	g (g').	Jig hole (ϕ10 mm)
b (b').	Front stabilizer bracket front installation hole	h (h').	Jig hole (ϕ10 mm)
c (c').	Front stabilizer bracket rear installation hole	i (i').	Trailing arm installation hole
d (d').	Suspension control arm installation front hole	j (j').	Bump stopper installation hole
e.	Rear engine mounting front installation hole (except sport model)	k.	Lateral rod installation hole
f (f').	Jig hole (ϕ15 mm)	l (l').	Jig hole (ϕ16 mm)

Hole to hole distance

a-f : 909 mm (35.79 in.)	**d'-g' : 708 mm (27.87 in.)**	**h-k : 1724 mm (67.87 in.)**
a-f' : 862 mm (33.94 in.)	**e-g : 702 mm (27.64 in.)**	**h-l : 1718 mm (67.64 in.)**
b-b' : 740 mm (29.13 in.)	**e-g' : 647 mm (25.47 in.)**	**h'-i : 1202 mm (47.32 in.)**
b'-g : 1464 mm (57.64 in.)	**f-f' : 754 mm (29.68 in.)**	**h'-j' : 1384 mm (54.45 in.)**
b'-g' : 1259 mm (49.57 in.)	**f-g : 471 mm (18.54 in.)**	**h'-k : 1497 mm (58.94 in.)**
c-c' : 968 mm (38.11 in.)	**f-g' : 889 mm (35.00 in.)**	**h'-l : 1940 mm (76.38 in.)**
c-g : 1148 mm (45.20 in.)	**g-g' : 754 mm (29.68 in.)**	**i-i' : 1017 mm (40.04 in.)**
c-g' : 1431 mm (56.34 in.)	**g'-h : 791 mm (31.14 in.)**	**i-l' : 1390 mm (54.72 in.)**
c'-d : 970 mm (38.19 in.)	**g'-h' : 240 mm (9.45 in.)**	**i'-l' : 918 mm (36.14 in.)**
c'-d' : 452 mm (17.80 in.)	**h-h' : 754 mm (29.68 in.)**	**j-j' : 1028 mm (40.47 in.)**
d-d' : 761 mm (29.96 in.)	**h-i : 825 mm (32.48 in.)**	**l-l' : 1076 mm (42.36 in.)**
d'-g : 1037 mm (40.83 in.)	**h-j' : 1640 mm (64.57 in.)**	

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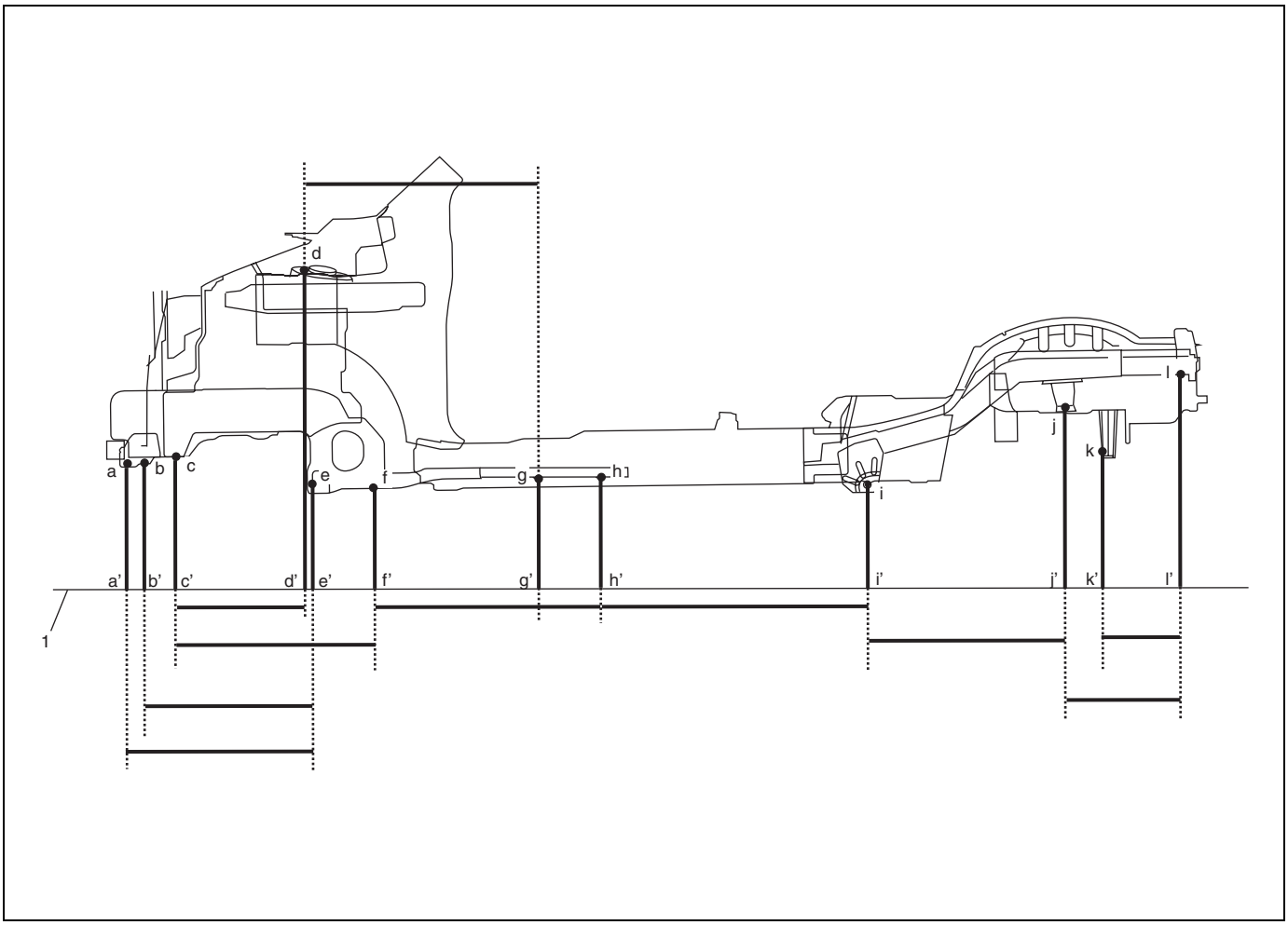

1. Virtual baseline	g. Jig hole (ϕ10 mm)
a. Jack bracket installation hole	h. Jig hole (ϕ10 mm)
b. Front stabilizer bracket front installation hole	i. Trailing arm installation hole
c. Front stabilizer bracket rear installation hole	j. Bump stopper installation hole
d. Strut installation front hole	k. Lateral rod installation hole
e. Suspension control arm installation front hole	l. Jig hole (ϕ16 mm)
f. Jig hole (ϕ15 mm)	

Point to point distance

a-a': 133 mm (5.24 in.)	**e-e': 77 mm (3.03 in.)**	**i-i': 85 mm (3.35 in.)**
a'-e': 558 mm (21.97 in.)	**e'-f': 238 mm (9.37 in.)**	**i'-j': 546 mm (21.50 in.)**
b-b': 133 mm (5.24 in.)	**f-f': 55 mm (2.17 in.)**	**j-j': 292 mm (11.50 in.)**
b'-e': 550 mm (21.65 in.)	**f'-g': 470 mm (18.50 in.)**	**j'-l': 324 mm (12.76 in.)**
c-c': 162 mm (6.38 in.)	**g-g': 80 mm (3.15 in.)**	**k-k': 139 mm (5.47 in.)**
c'-d': 391 mm (15.39 in.)	**g'-h': 240 mm (9.45 in.)**	**k'-l': 193 mm (7.60 in.)**
c'-e': 432 mm (17.01 in.)	**h-h': 80 mm (3.15 in.)**	**l-l': 375 mm (14.76 in.)**
d-d': 648 mm (25.51 in.)	**h'-i': 815 mm (32.09 in.)**	
d'-g': 749 mm (29.49 in.)		

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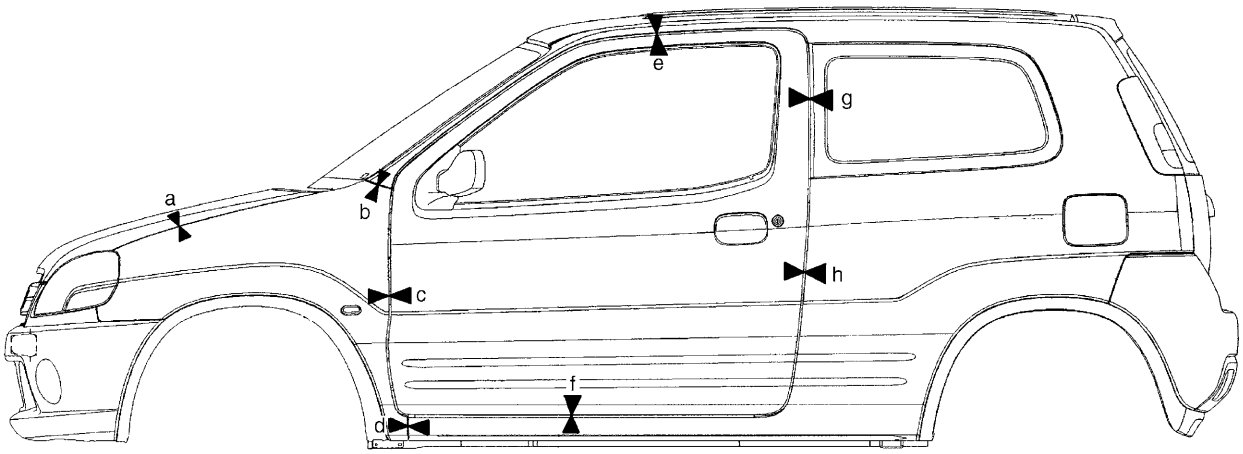
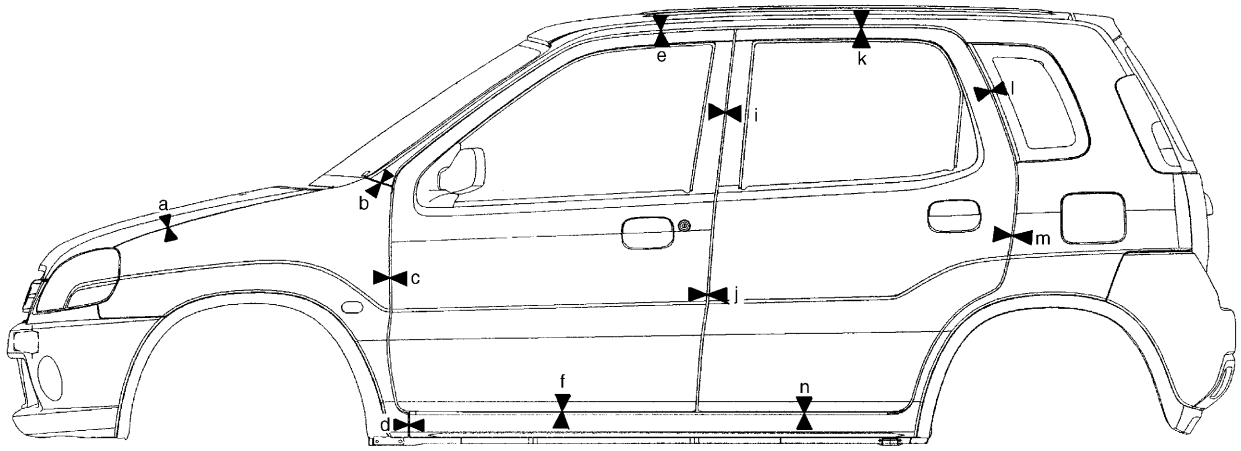
Panel Clearance

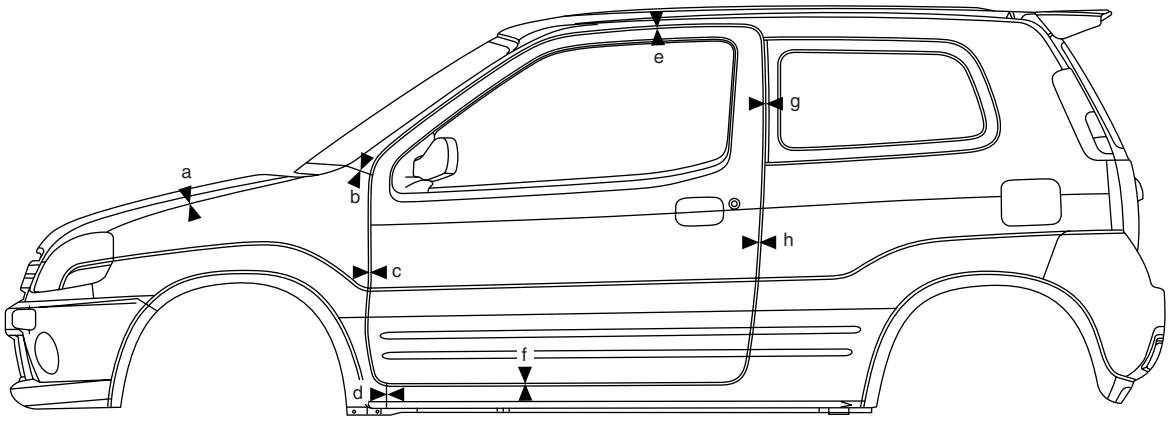
[A]



[B]



[C]



[A]: 3 door model (except sport model)	[B]: 5 door model	[C]: Sport model

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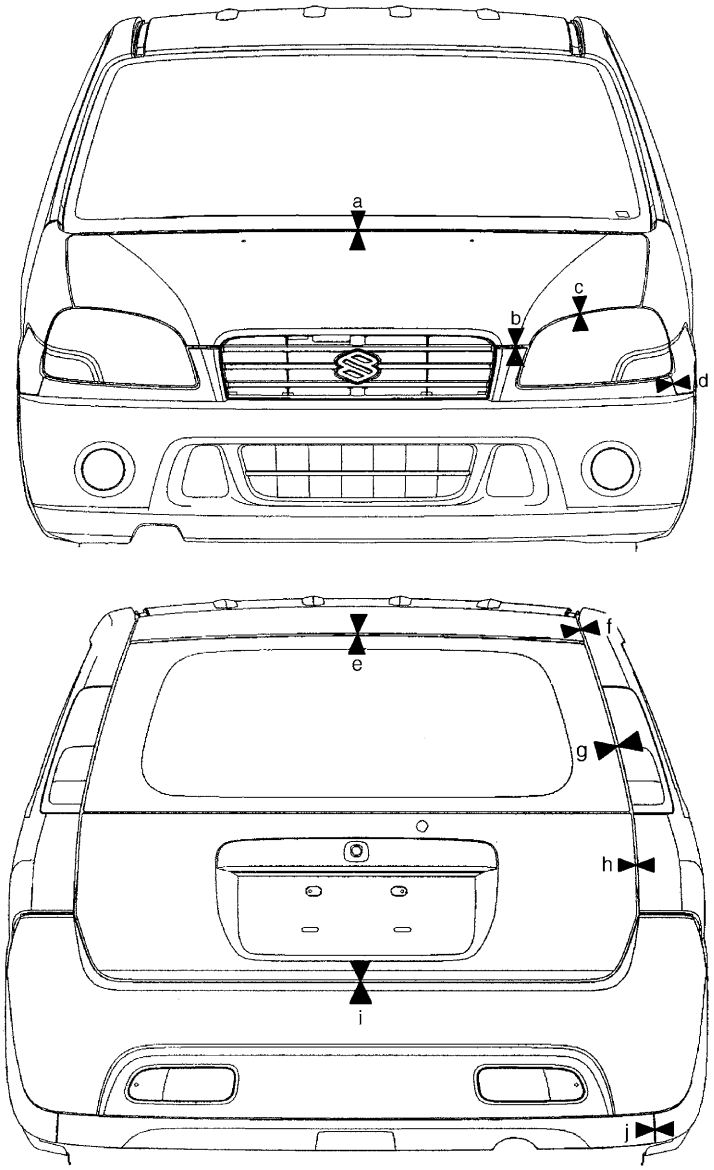
Panel to panel distance

a : 2.4-4.4 mm (0.094-0.173 in.)	h : 3.6-5.6 mm (0.142-0.220 in.)
b : 1.7-3.7 mm (0.067-0.146 in.)	i : 3.6-5.6 mm (0.142-0.220 in.) 5 door model
c : 4.2-6.2 mm (0.165-0.244 in.)	j : 4.2-6.2 mm (0.165-0.244 in.) 5 door model
d : 1.0-3.0 mm (0.039-0.118 in.)	k : 5.0-7.0 mm (0.197-0.276 in.) 5 door model
e : 5.0-7.0 mm (0.197-0.276 in.)	l : 4.3-6.3 mm (0.169-0.248 in.) 5 door model
f : 4.7-6.7 mm (0.185-0.264 in.)	m : 3.6-5.6 mm (0.142-0.220 in.) 5 door model
g : 4.3-6.3 mm (0.169-0.248 in.)	n : 4.7-6.7 mm (0.185-0.264 in.) 5 door model



Panel to panel distance

a : 4.8-6.8 mm (0.189-0.268 in.)	f : 3.5-5.5 mm (0.138-0.217 in.)
b : 6.6-8.6 mm (0.260-0.339 in.)	g : 4.3-6.3 mm (0.169-0.248 in.)
c : 3.7-5.7 mm (0.146-0.244 in.)	h : 3.6-5.6 mm (0.142-0.220 in.)
d : 1.5-2.5 mm (0.059-0.098 in.)	i : 5.3-7.3 mm (0.209-0.287 in.)
e : 7.1-8.6 mm (0.280-0.339 in.)	j : 1.0-3.0 mm (0.039-0.118 in.) except sport model

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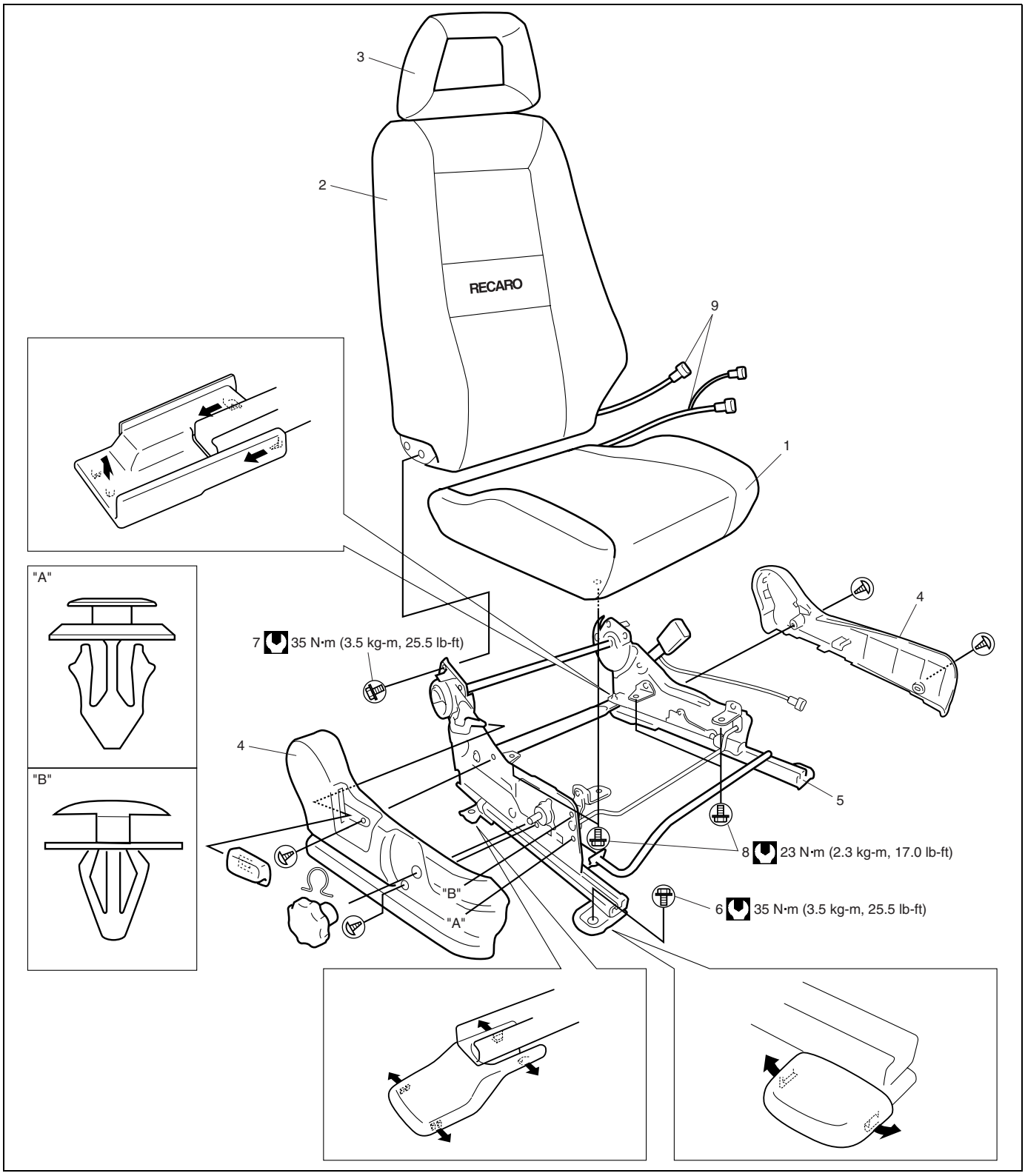
Seats

Front Seat

NOTE:

For 1.3 L engine model, refer to the same section of the Service Manual mentioned in "FOREWORD" of this manual.

Sport model



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1. Seat cushion	4. Cover	7. Reclining bolt	Tightening torque
2. Seat back	5. Seat adjuster	8. Seat cushion bolt	
3. Head rest	6. Seat adjuster bolt	9. Seat heat lead wire connector	

Removal

1) Remove console box.
2) Disconnect seat heater lead wire connector (9), if equipped.
3) Remove 4 mounting bolts to remove seat assembly.
4) Disassemble and repair seat as necessary.

Installation

Reverse removal procedure to install front seat.
Torque to specifications as shown.

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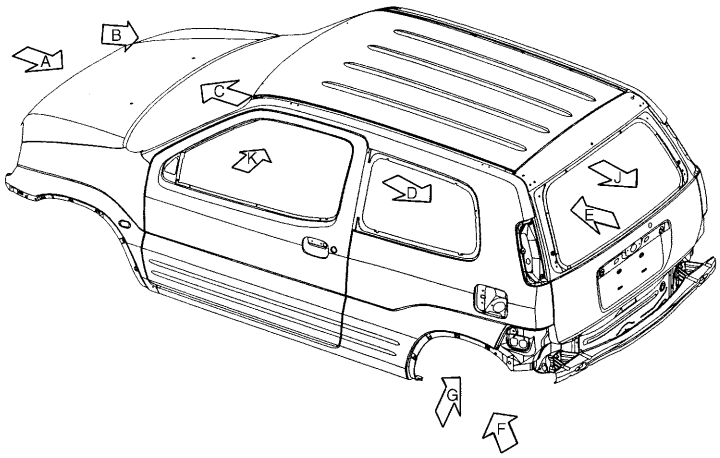
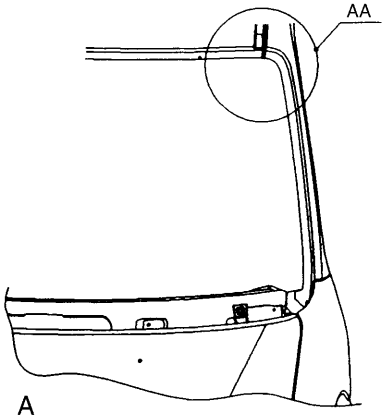
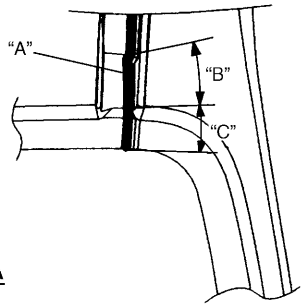
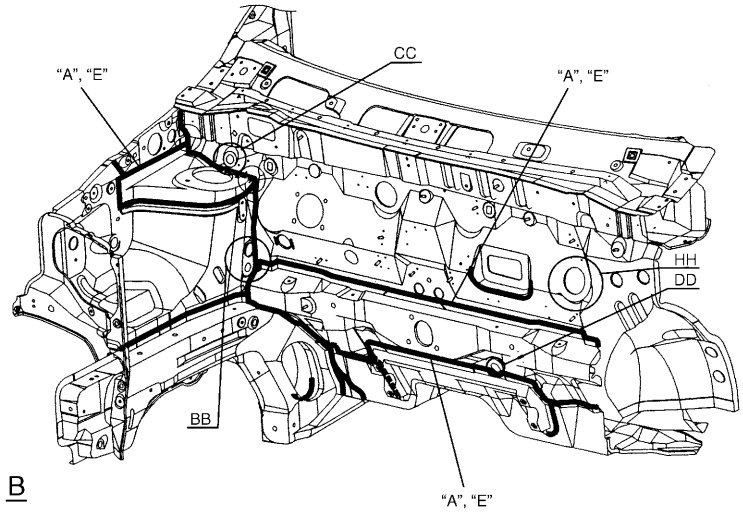
Paint and Coatings

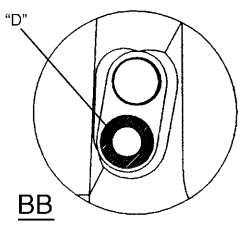
Sealant Application Areas

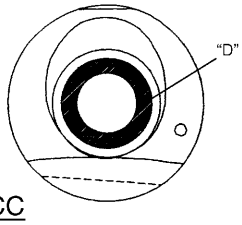


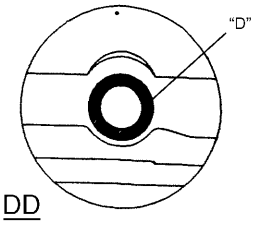


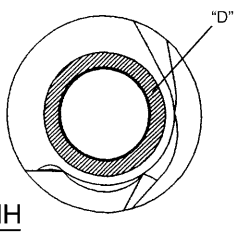












"A" : Apply sealant	"C" : Wipe off excess sealant after application	"E" : Smooth out sealant with a brush
"B" : Apply sealant without heeling	"D" : Do not apply sealant	

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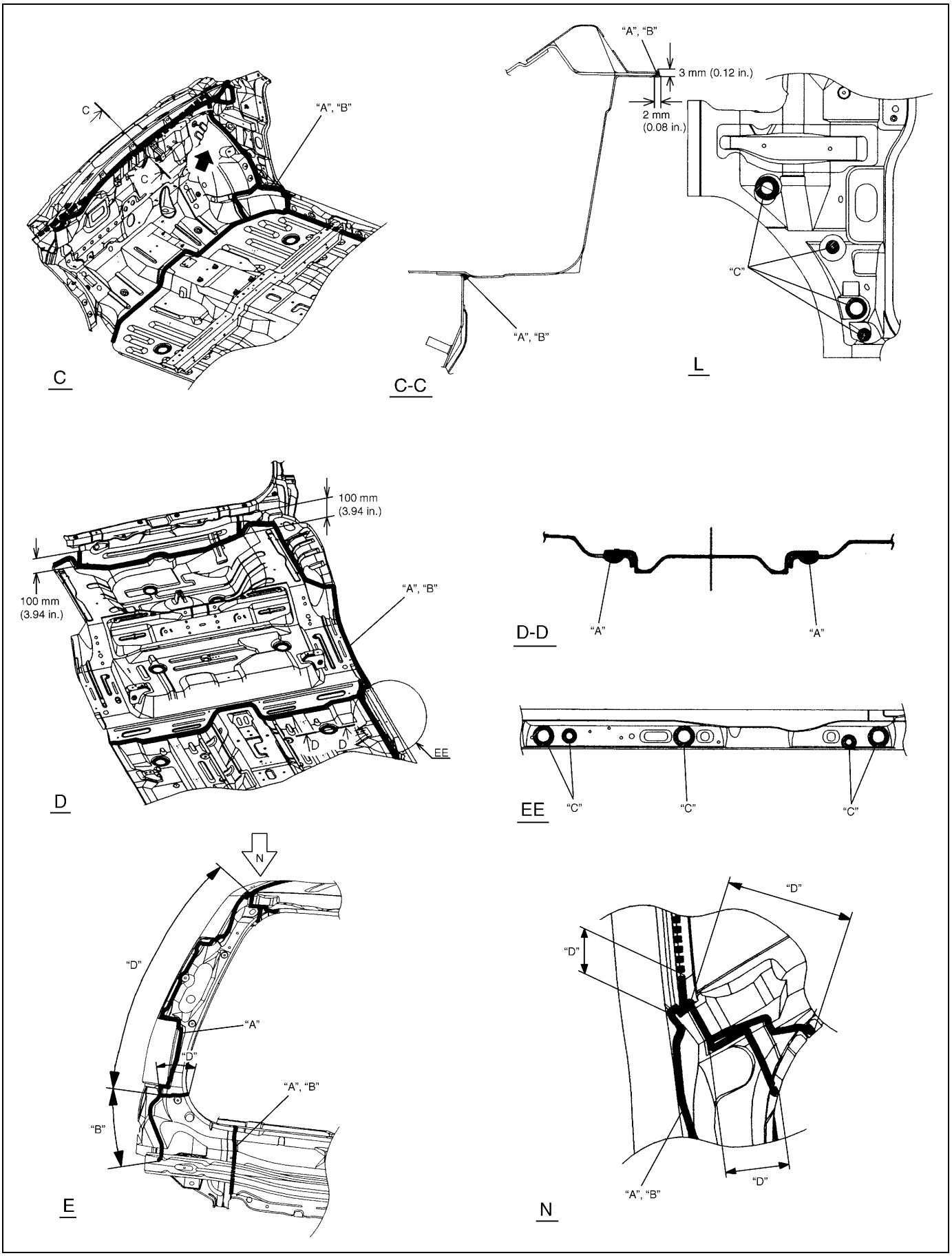

"A" : Apply sealant	"C" : Do not apply sealant
"B" : Smooth out sealant with a brush	"D" : Wipe off excess sealant after application

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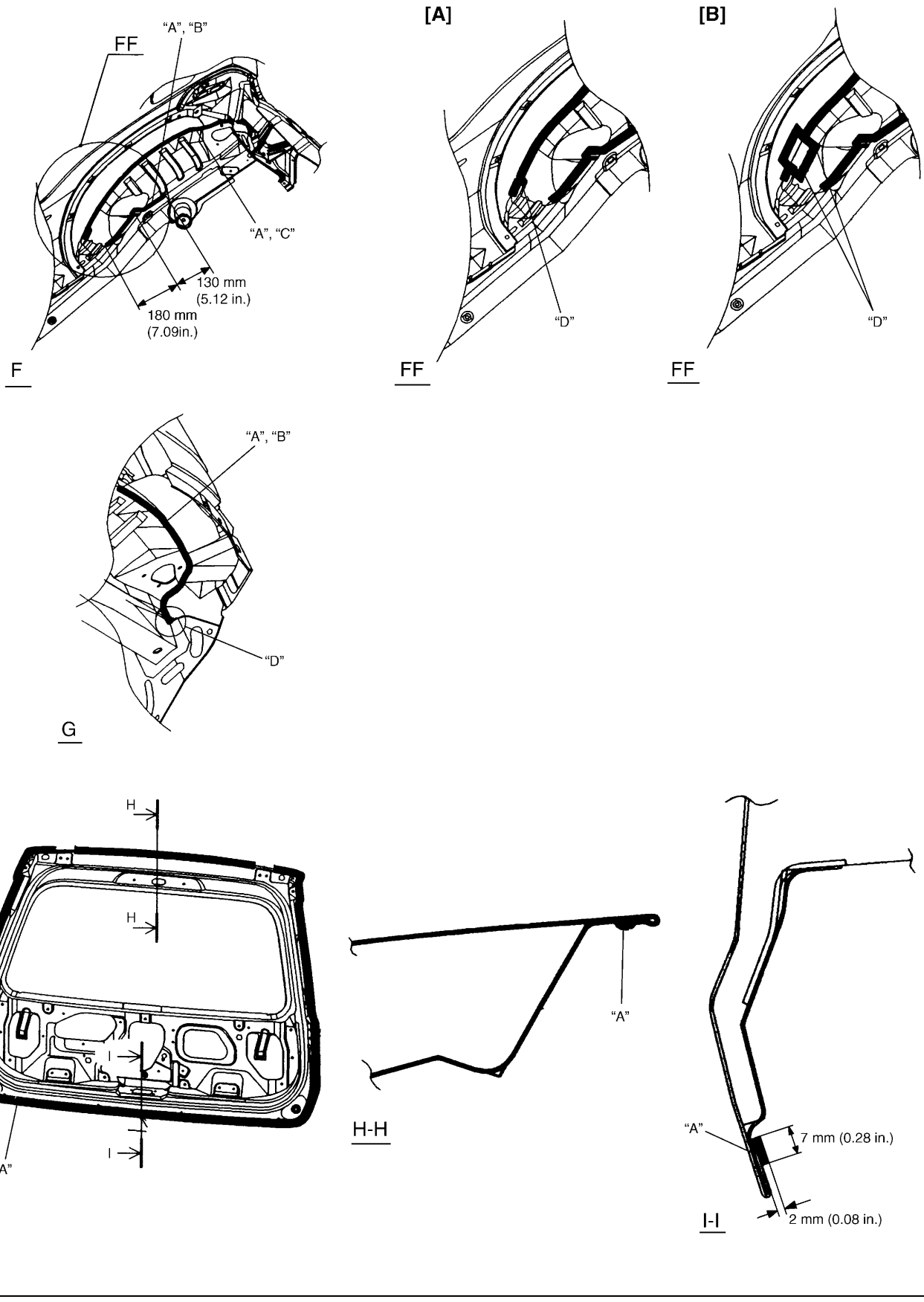

[A] : 3 door model	"A" : Apply sealant	"C" : Smooth out sealant with a brush
[B] : 5 door model	"B" : Wipe off excess sealant after application	"D" : Fill gap/hole with sealant

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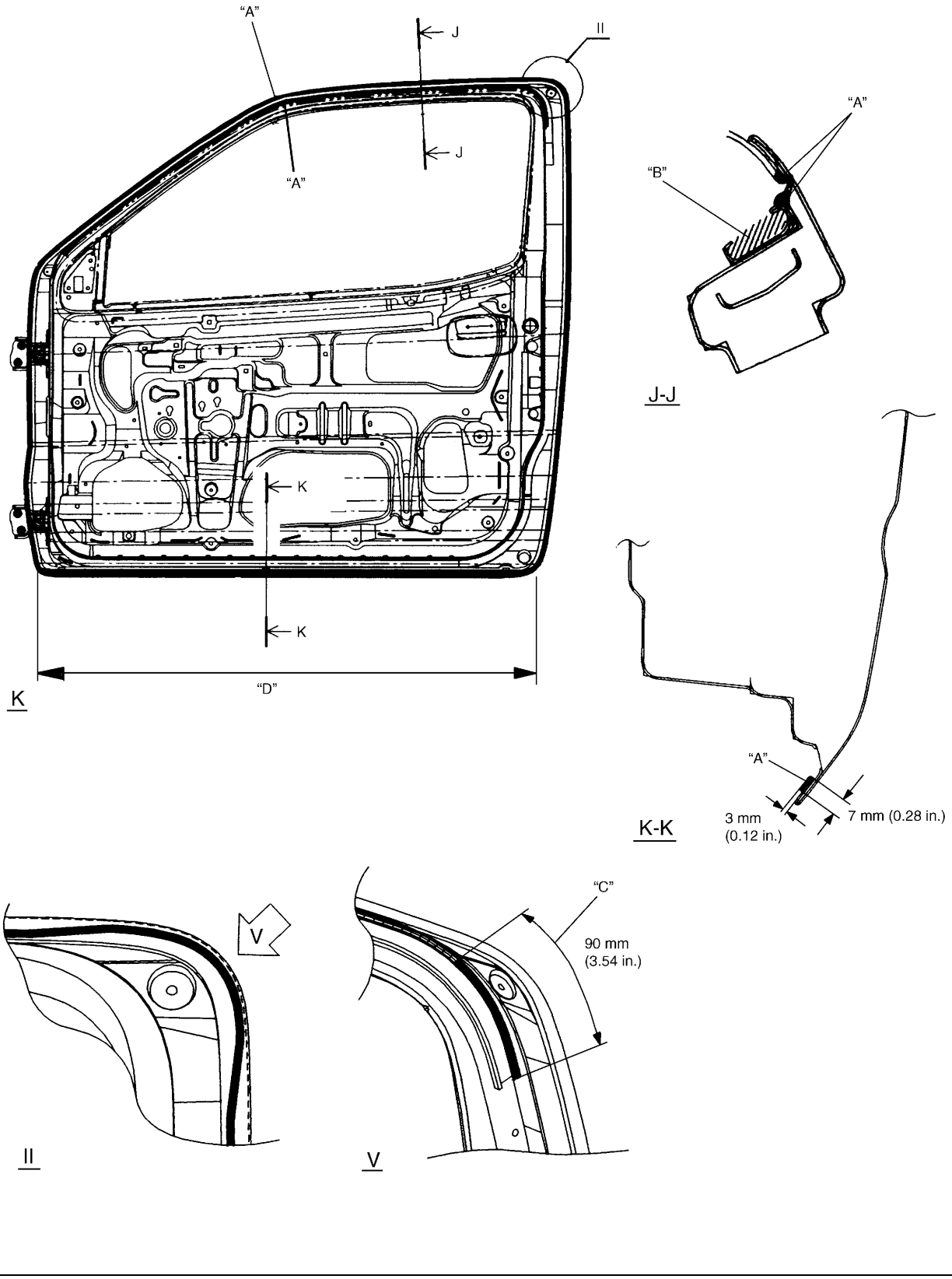

[A] : 3 door model	"C" : Wipe off excess sealant after application
"A" : Apply sealant	"D" : Never fill up drain holes with sealant
"B" : Be free from swell and protruded on hatched part	

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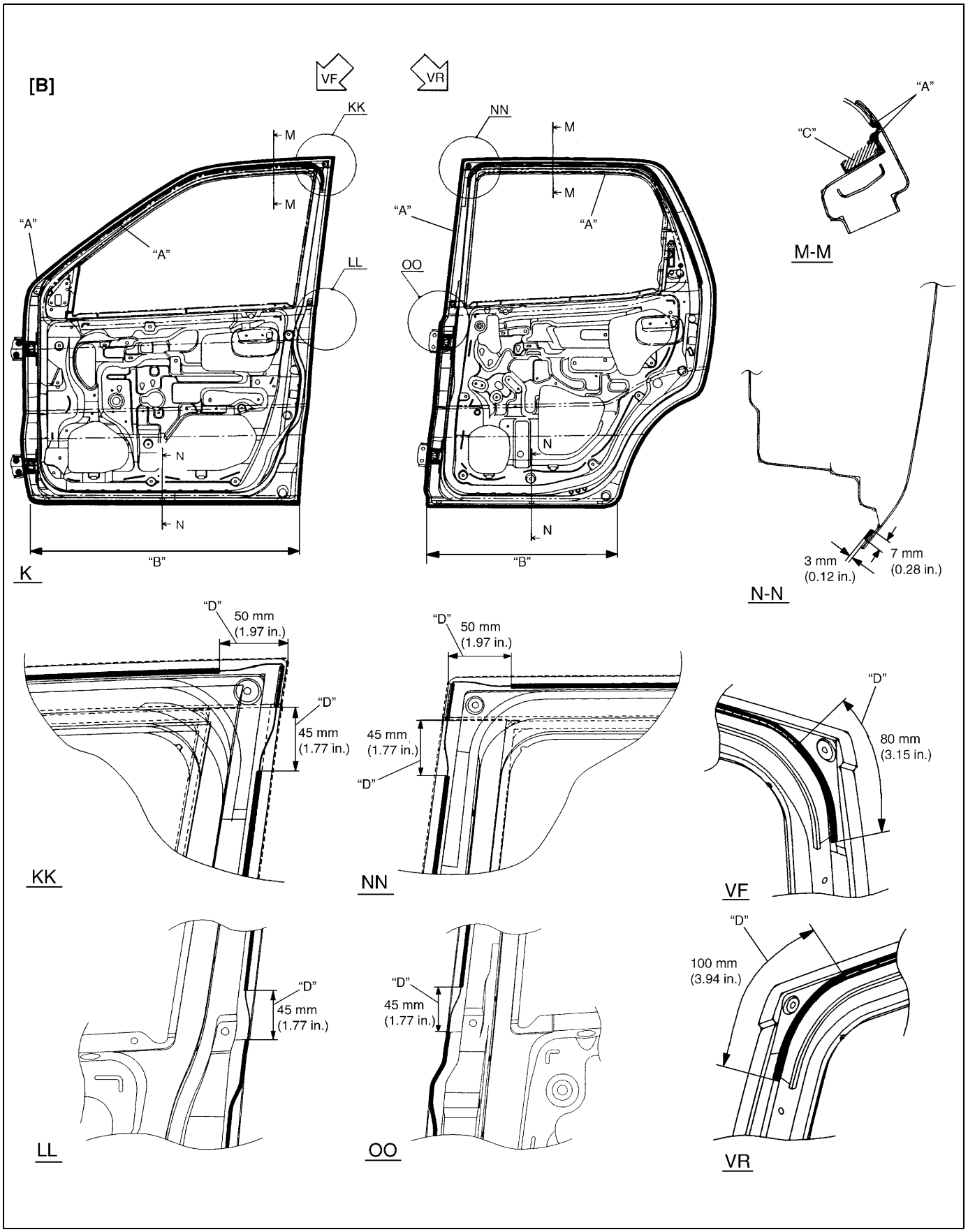

[B] : 5 door model	"C" : Be free from swell and protruded on hatched part
"A" : Apply sealant	"D" : Wipe off excess sealant after application
"B" : Never fill up drain holes with sealant	

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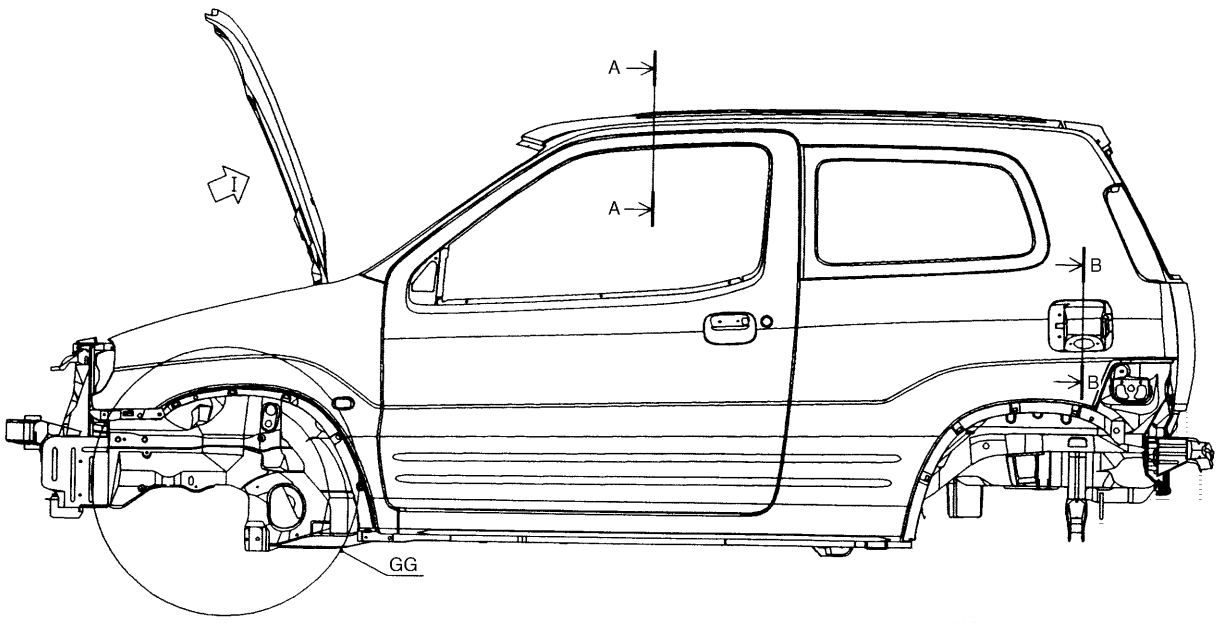

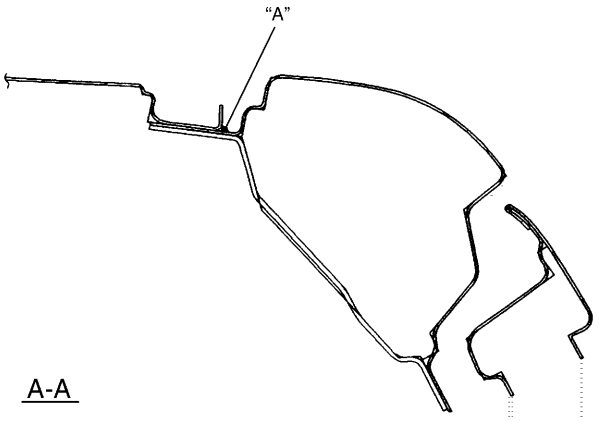

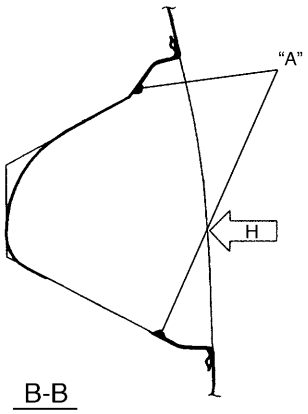

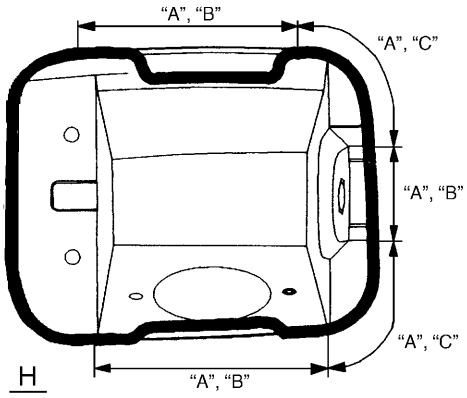

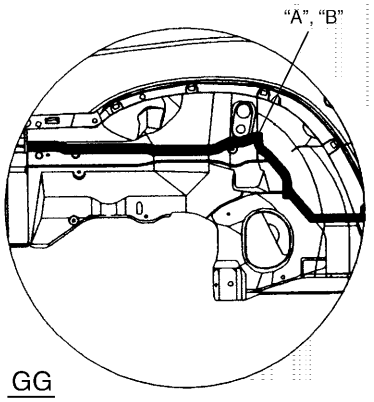

"A" :	Apply sealant
"B" :	Smooth out sealant with a brush
"C" :	Wipe off excess sealant after application

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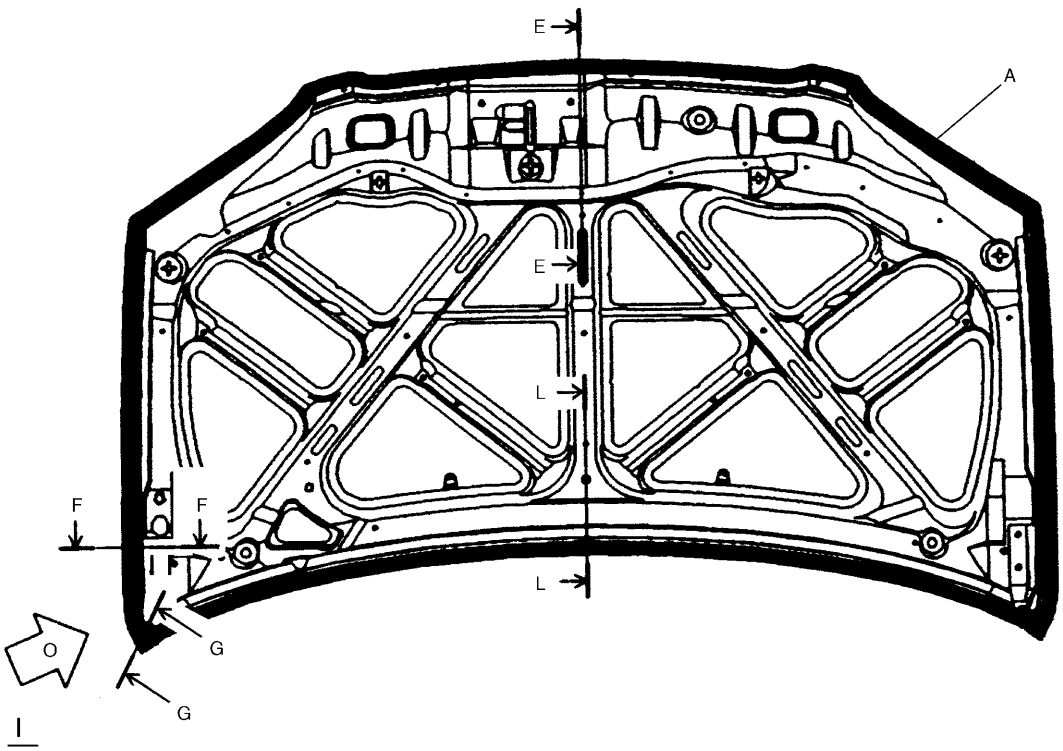

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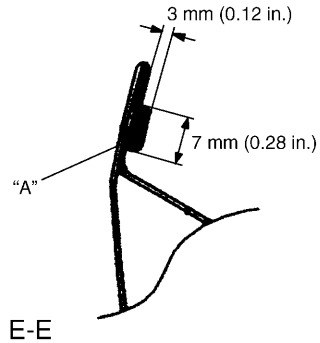

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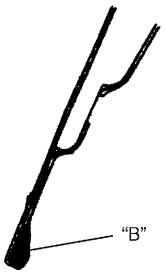

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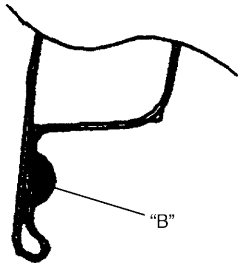

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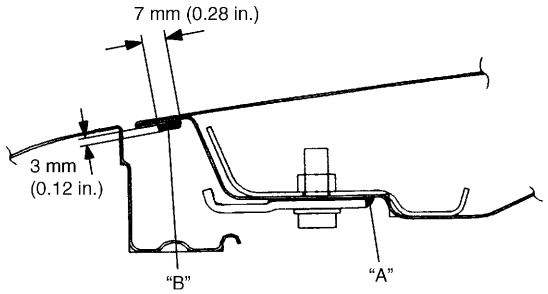
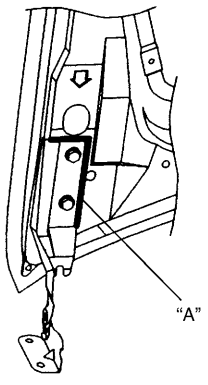


F-F



O

"A" :	Apply sealant
"B" :	Apply sealant so that top of flange covered up certainly

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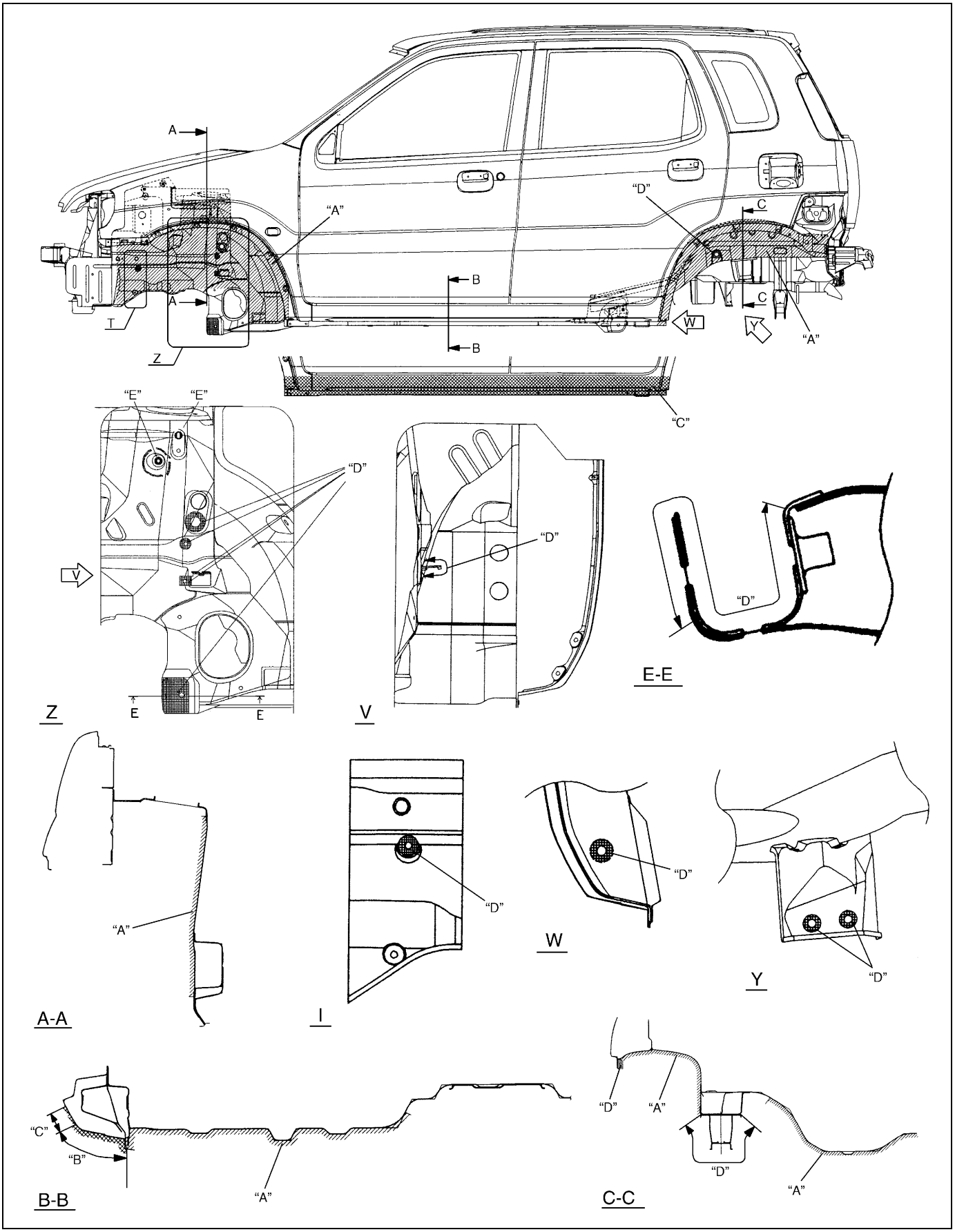
Under Coating Application Areas



"A": Apply undercoating (PCV, 400 µm or more)	"C": Apply anti-chip coat (300 µm or more)	"E": Do not apply under coating (Left-side only)
"B": Apply anti-chip coat (100 µm or more)	"D": Do not apply undercoating	

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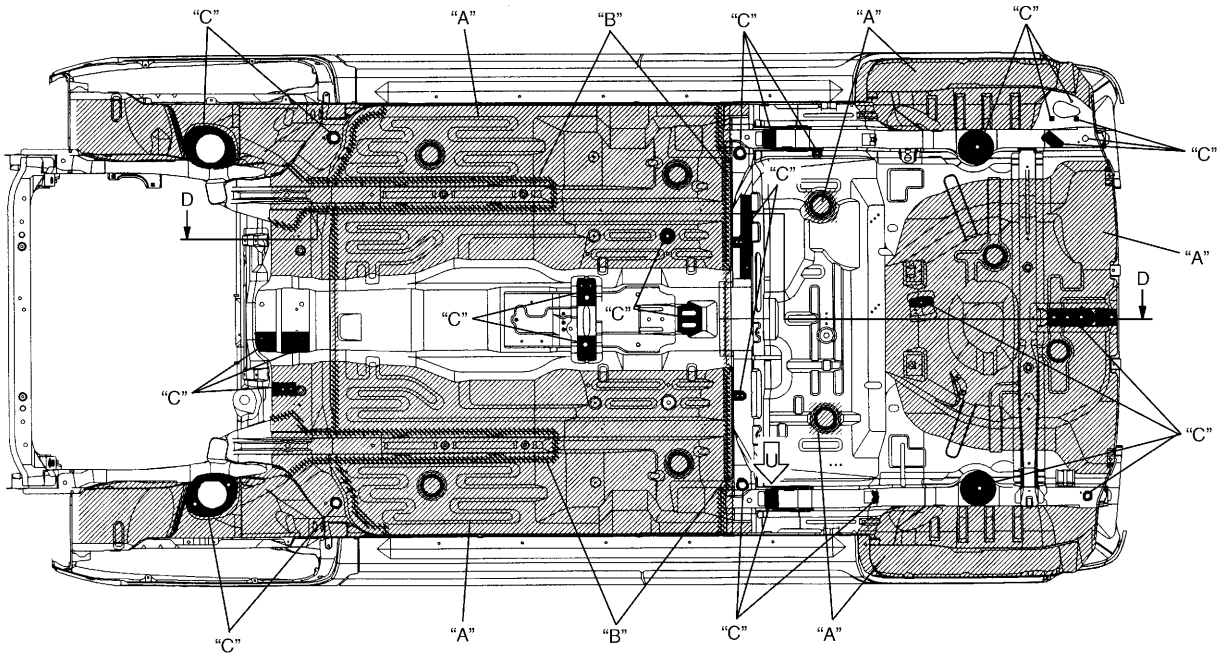
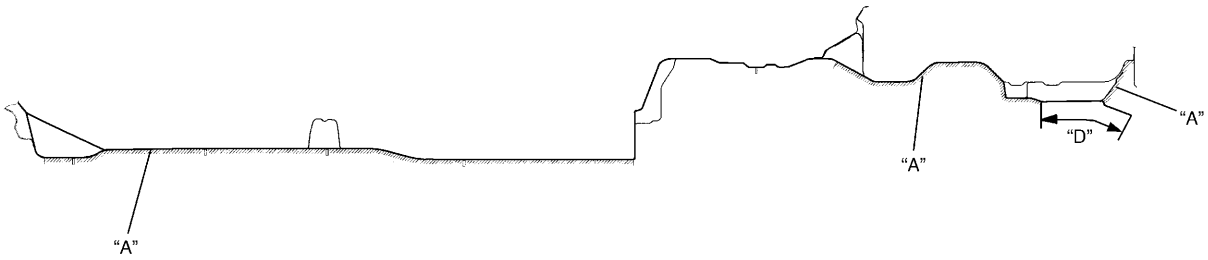
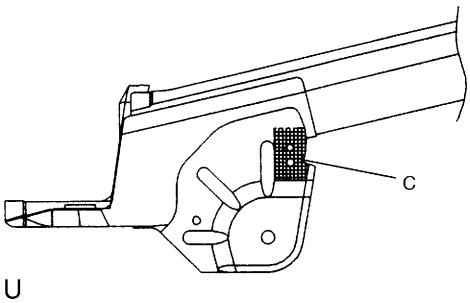




D-D



U

"A" :	Apply undercoating (PCV, 400 µm or more)
"B" :	Apply undercoating (PCV, 600 µm or more)
"C" :	Do not apply undercoating

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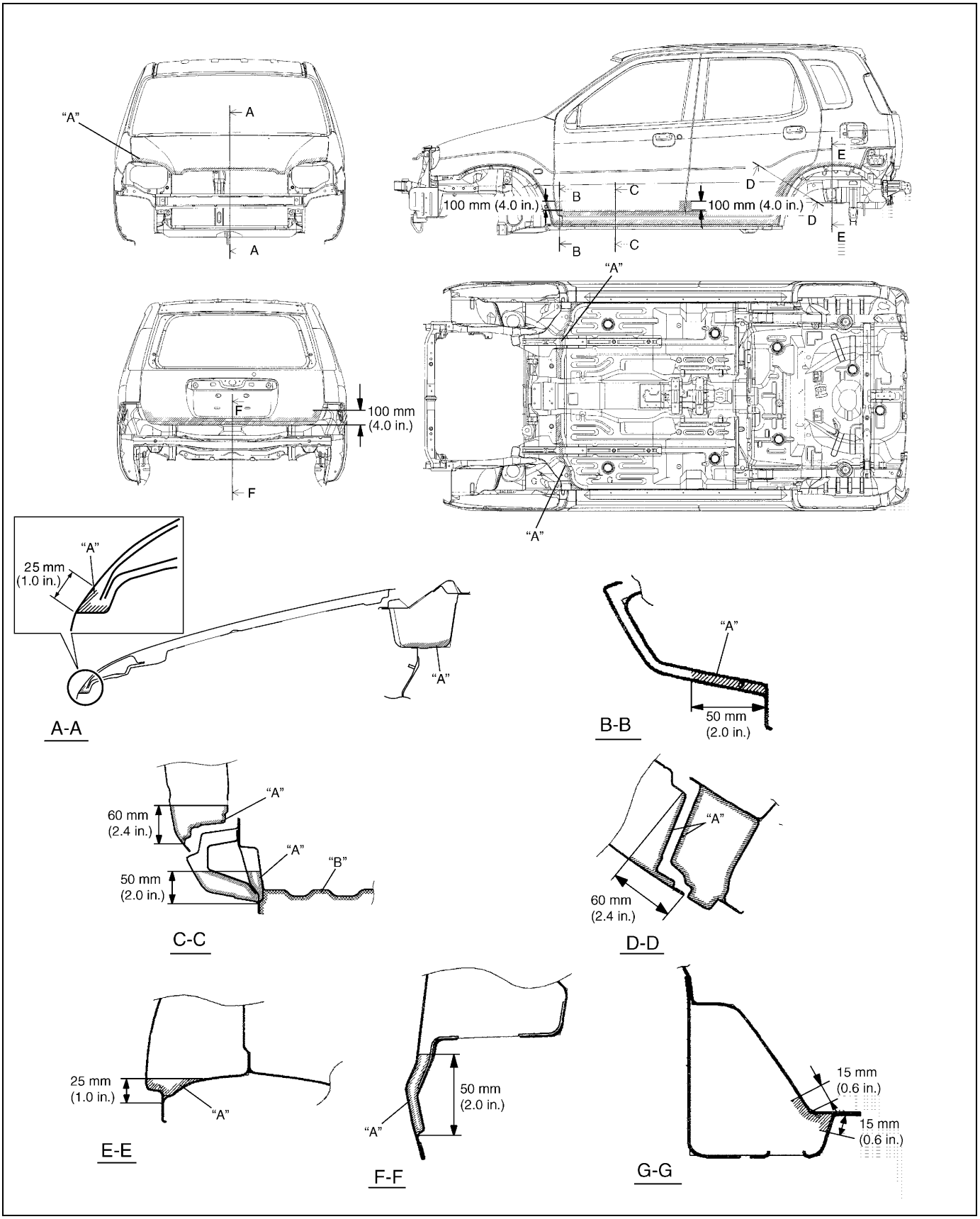
Anti-corrosion Compound Application Area



"A":	Apply rust proof wax (hot wax 50 µm or more)
"B":	Apply rust proof wax (high viscosity wax 50 µm or more)

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Plastic Parts Finishing

Paintable plastic parts are ABS plastic parts.

Painting

Rigid or hand ABS plastic needs no primer coating.
General acrylic lacquers can be painted properly over hard ABS plastic in terms of adherence.

1) Use cleaning solvent for paint finish to wash each part.
2) Apply conventional acrylic color lacquer to part surface.
3) Follow lacquer directions for required drying time. (Proper drying temperature range is 60 – 70 °C (140 – 158 °F)).

Reference

Plastic parts employ not only ABS (Acrylonitrile Butadiene Styrene) plastic but also polypropylene, vinyl, or the like plastic. Burning test method to identify ABS plastic is described below.

1) Use a sharp blade to cut off a plastic sliver from the part at its hidden backside.
2) Hold sliver with pincers and set it on fire.
3) Carefully observe condition of the burning plastic.
4) ABS plastic must raise readily distinguishable back smoke while burning with its residue suspended in air temporarily.
5) Polypropylene must raise no readily distinguishable smoke while burning.

Required Service Material

Material	Recommended SUZUKI product	Use
Lithium grease	SUZUKI SUPER GREASE A (99000-25010)	• Window regulator • Door hinge
Sealant	SUZUKI BOND No. 1215 (99000-31110)	• Hood hinge • Door hinge

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